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EDITORIAL

The Value of Tests

One of the problems facing users of materials as well as those concerned with their production is how to evaluate test data. More properly, the problem is how to interpret test data in order to tell whether the particular material will meet conditions imposed by a proposed application.

To focus attention on the problem, Dr. H. W. Gillette of Battelle Memorial Institute presented a paper on "Present Knowledge of Low-Carbon 18:8" before the recent A.S.T.M. meeting in Atlantic City. As Dr. Gillette pointed out, both carbon and nitrogen would have to be impractically low in 18:8 stainless to make the steel absolutely resistant to precipitation and grain boundary corrosion under any and all conditions.

Conventional laboratory methods of evaluating these characteristics are largely of an artificial nature and might often result in satisfactory material being discarded when such tests are specified.

Where the trouble lies is in the fact that tests of the type referred to are always conducted under precise conditions and can lead to false assumptions.

One example of a test that often leads to false assumptions is the overworked salt spray tests, so much in evidence during the war. Comparisons between these tests and actual exposure to salt-laden atmospheres show little if any relationship, other than showing the relative corrosion resistance between any of a group of materials or finishes.

Does this mean that laboratory tests are of little value? Decidedly not. What is shown by the situation is that further tests should be conducted by those planning to use a material to see that the material under consideration will fulfill its requirements. Laboratory test data should be used to weed out those materials which are certain to be unfit.

On what kind of a test can we rely? The answer is remarkably simple. Test the materials in their final fabricated forms under actual conditions of service. In some cases time will permit full field tests, which is the ideal. In other circumstances, simulated service tests can prove satisfactory.

It is much more economical in the long run to know exactly how the materials you have selected will behave, than to encounter failures in the field. The latter certainly will cause economic losses, if not actual loss of lives and a reduced confidence in the product's maker.

Many companies are now engaged in heavy service tests for a large proportion of their products. Many more should.

T. C. Du Mond
Editor

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(Courtesy American Airlines)

Continued advancement in aircraft depends to a great extent upon the intelligent application of existing materials, and this article tells how materials engineers are doing their part of this job.

Materials in the Aircraft Industry

by CLYDE WILLIAMS, Director, Battelle Memorial Institute

• THE PRIMARY PROBLEM that must be faced in the design and production of aircraft is to get the results wanted with as little weight as possible. High operating costs ride with too much weight; catastrophe may ride with too little. The margin between is exceedingly small and unless materials engineers, designers and basic scientists work well together, one penalty or the other will be paid.

In this article, the intent is to tell how materials engineers are doing their part of this job. First, a brief review of what we know about present structural materials for aircraft will be given, and the major gaps in that information will be indicated. Next, possible new materials for aircraft of the future will be described, and finally some factors, other than purely technological ones, which influence the choice of materials will be pointed out.

Status of Information on Materials

Most aircraft structural elements operate in a temperature range from —80 to +150 F. In this range few practical materials undergo important metallurgical changes. Furthermore, time is ordinarily not an important variable in establishing strength properties. In designing aircraft components, one is fenced in on the one hand by elastic stability and on the other by plastic stability or fracture. Successful designs fall between these two limits.

In the temperature range cited previously, where time is unimportant, our knowledge of elastic properties is reasonably adequate. At present, designers assume materials are isotropic and homogeneous. Actually, aluminum is the only commonly used aircraft material that is almost isotropic elastically—even in single crystals. However, most metals and alloys behave as if they were elastically isotropic for all practical purposes. This is true because they are polycrystalline. Preferred orientations resulting from manufacture sometimes cause elastic moduli to vary in different directions. In general, these variations are not large enough to matter, chiefly because of the difficulty of reproducing heats. For the same reason, variations in elastic moduli with temperature in this range are ordinarily not important. That's the way it stands today. Tomorrow's design methods may call for further details. Fortunately, much work is already being done.

It should be pointed out here that as soon as we start dealing with fine details, the problem of gathering data becomes astonishingly complicated. The necessary refinement in experimental techniques is but one reason. Even basic definitions are no longer adequate. Here is an example: As soon as interest in the elastic modulus of a material becomes so refined that hysteresis and relaxation effects become important, the ordinary definition of elastic modulus no longer serves. This situation occurs again and again. Materials engineers must continually take time off from developing more comprehensive material data in order to revise fundamental definitions of the properties they are measuring.

Now let us turn to strength properties available for designing structures for plastic stability and against fracture. They can be summarized as follows:

Conventional tensile properties such as yield strength, tensile strength and ductility are abundant for most materials. Unfortunately, these data are of least importance. Detailed stress-strain curves in compression are much more important, for they determine the limits of plastic stability. More and more of such data are becoming available. For the more important aluminum and magnesium alloys and for some steels, the information is now rather complete. But even though data exist, they cannot be used with complete confidence.

Tension and compression properties sometimes vary in materials. Likewise, properties vary in specimens taken in different directions. We have measured these in specific instances, but we do not understand them well enough to make full use of them.

A large body of fatigue data has also been obtained on specific materials tested under specialized conditions. But again, our lack of fundamental understanding is an obstacle. It hampers both the use of data we have, and our decisions as to just what additional data we need.

Practically no fatigue failures occur in smooth straight sections; they mostly occur at stress concentration of one kind or another. Accordingly, the basic needs at present are better understanding and more data on the effect of stress concentration.

There are also brittle fractures other than fatigue failures. Design against these is also in a primitive stage of development both from the standpoint of materials information and design. The materials problem may be stated simply by saying that the materials engineer does not know what properties to measure. Conventional measurements of ductility are not sufficient, and data on the effect of stress raisers are only qualitative. A great deal of effort is now being applied to this problem.

It is becoming increasingly important to know what materials do at elevated temperatures. De-icers operate at temperatures up to 350 F. Time and metallurgical changes begin to affect most aluminum and magnesium alloys at that temperature. Structures next to jets and skins heated by air friction at supersonic speeds may reach temperatures of 1000 F. Engine parts and combustion chambers in jet and other types of planes operating on the gas-reaction principle now have parts running at temperatures up to 1800 F. Even higher temperatures might be used if materials could stand them.

At high temperatures, metallurgical changes and time affect the measurement of strength properties. These produce endless complications. We need tremendous amounts of new data. Even some of our definitions that were previously accepted begin to break down.

There is a reasonably large body of tensile creep data covering many materials; however, the data that have been obtained in the past are of most value in estimating the relative worth of materials and are usually not suitable for use by the designer.

Aircraft Materials

Some specific aircraft materials will now be discussed and the probable extent of improvements which can be foreseen will be outlined.

Aluminum Alloys — The elastic moduli of aluminum alloys are around 10,000,000 psi.; their specific gravity lies between 2.7 and 2.8. These values fix the minimum weight of a structure that will be elastically stable. While a few highly alloyed aluminum alloys (those containing high contents of beryllium) have moduli as high as 15,000,000 psi., it does not seem that any commercial alloys will be developed that will have elastic properties substantially different from those cited.

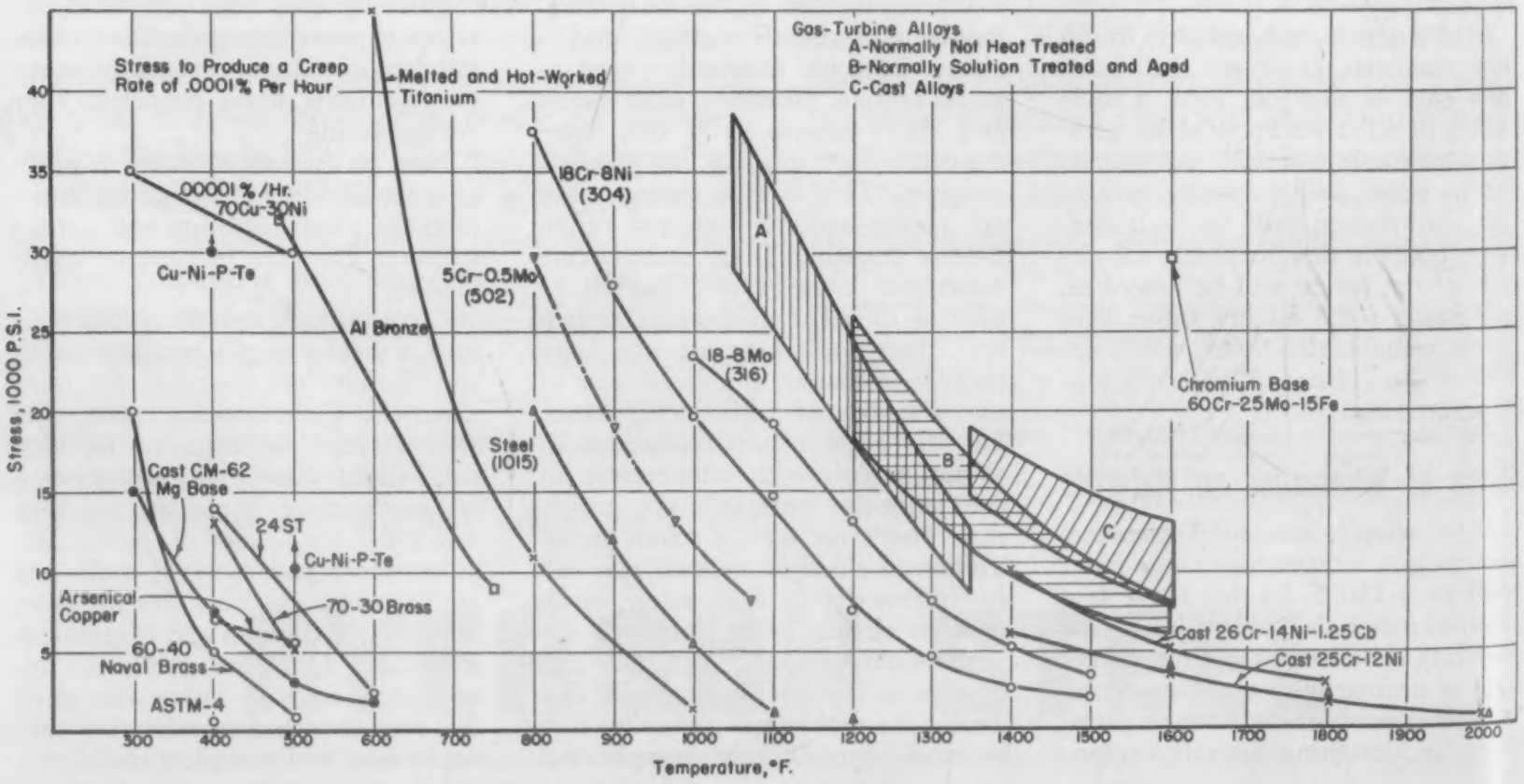
The recent introduction of the 75S-T type of alloy has raised the useful range of allowable compression stress in aluminum alloys to about 70,000 psi. The development of the 75S-T type of alloy was a real achievement. To develop alloys of still better properties will represent an even greater accomplishment. While progress may be expected, it is likely to be gradual and take a long time to effect a real improvement.

Aluminum alloys are not adversely affected by extremely low temperatures, and, therefore, no particular problem exists for this type of service.

Magnesium Alloys — Magnesium alloys, already important in aircraft engine parts, are becoming increasingly important in the airframe. Although their elastic moduli are only around 6,500,000 psi., their density is low. As a result, magnesium alloys, on a weight basis, have elastic stability superior to the aluminum alloys. This feature makes them attractive for aircraft skin. The difficulties with stress corrosion which some of you meet are now better understood and are no longer a serious problem.

The main shortcoming of magnesium alloys is their rather low tensile and even lower compressive prop-

Stress-temperature relationship producing a secondary creep rate of 0.0001% per hr. for alloys used at elevated temperatures.



erties. Some progress is being made. Magnesium-lithium base alloys, developed at Battelle, and containing 10.3% or more of lithium, are body-centered cubic instead of hexagonal. As a result, they have some advantages: (1) They have less anisotropy. (2) They have better compressive properties. (3) They have better forming characteristics. (4) Their density is low, their strength is high so that, on a strength-weight basis, they are equivalent to the best aluminum alloys. (5) Their modulus of elasticity is only 6,500,000 psi., but their low density makes them possess, on a weight basis, the highest elastic stability of any structural material.

But all of these advantages are not enough. The alloys still require improvements in three respects: (1) structural stability in the temperature range of 150 to 200 F; (2) resistance to corrosion; and (3) cost.

In addition to potential technological advantages, there is an even stronger reason for continued development and use of magnesium alloys. This is the supply available. The present capacity of the United States for producing primary aluminum is about 730,000 tons per year. In 1948, actual production almost reached capacity and the demand was greater than the supply. On the other hand, the capacity for magnesium is about 112,000 tons per year, but in 1948 only about 10,000 tons was produced. Thus, there is idle capacity for making magnesium. Furthermore, the power required for producing magnesium is only about half that required for aluminum. Finally, the two principal sources of magnesium, sea water and dolomite, are available in this country in unlimited quantities. By contrast, most of our supply of bauxite for aluminum production comes from foreign sources.

Thus, in order to safeguard against a possible scarcity of aluminum during another emergency, it would be well to use magnesium alloys whenever they are applicable.

The accompanying table illustrates the relative properties of structural materials in the temperature range from —80 to ±150 F. In this table two materials, titanium and ceramics, are included which are not yet being used commercially. The point of including these is that they represent our present ideas of what improvements may be expected in the foreseeable future. Note that it does not now appear that materials are going to be improved by more than a factor of two. This does not mean that present designs cannot be improved more than this amount, since we do not yet know how to use present materials for best efficiency.

Strength-Weight Properties of Aircraft Structural Materials

(All materials compared with 24S-T aluminum alloy)

Material	Elastic Stability		Plastic Stability	Fatigue Strength
	Slender Columns	Wide Columns, Panels, etc.		
24S-T Aluminum Alloy	1.0	1.0	1.0	1.0
75S-T Aluminum Alloy	1.0	1.0	1.7	1.0
Magnesium Alloy	1.25	1.35	0.37-1.05	0.5-1.4
Steels	0.60	0.55	0.42-1.6	0.5-1.5
Commercially Pure Titanium	0.78	0.72	0.90-1.08	1.0-1.6
Ceramics	2.0	1.7	—	—

High Temperature Materials—The gas turbine jet aircraft engine has brought before us an entirely new set of material problems. Materials now must operate under high stresses at elevated temperatures for long periods, and under restrictions as to permissible deformation. There are two general methods of handling these high-temperature material problems. One is to develop alloys which will withstand the high stresses and temperatures. The other is to design for auxiliary cooling so common materials of lower content of scarce and strategic metals can be used.

The accompanying chart shows the relative properties of various available materials for service at elevated temperatures. Aluminum and magnesium alloys are used for the moderate elevated temperatures in jet engine compressors. But even the strongest of these light alloys will carry only relatively low loads at 600 F. We are moving toward increased compression ratios. The accompanying higher temperatures that go with them will call for casings, blading and piping stronger than can be made from the light alloys.

Preliminary test data on titanium and titanium-base alloys indicate these materials will be very useful in the temperature range 600 to 1100 F, spanning the gap between the light alloys and the steels. Titanium appears to have about as good creep strength at 1000 F as the best aluminum-base alloy has at 600 F. At 600 F and for a creep rate of 0.0001% per hr., titanium shows a creep strength of more than ten times that of aluminum alloy 24S-T.

During the war, alloys were developed with properties indicated in Areas A, B and C of the chart. These are the so-called "super-alloys," and are chromium-nickel-iron, chromium-nickel-cobalt-iron and cobalt-base alloys strengthened by additions of molybdenum, tungsten and columbium, singly or in combination. These new alloys show greatly increased strengths in the temperature range of 1050 to 1600 F as compared with the straight chromium-nickel-iron alloys available previously.

An alloy in Group A called Timken 16-25-6 contains 16 chromium, 25 nickel and 6% molybdenum. This alloy has been used as the turbine rotor material for most of the turbo-superchargers and gas turbines. Turbine blades have been made from the more highly alloyed wrought and cast materials of still higher strengths from Groups B and C.

These improvements are impressive but the alloys exhibiting these properties use scarce, expensive and strategic metals from the group comprising chromium, nickel, cobalt, molybdenum, tungsten and columbium. Some of these metals are more plentiful than others. Some are either not available in significant quantities or are lacking altogether on the North American continent. A designer of structures or power plants for high-temperature operation should consider carefully the probability of supply and the strategic importance of the component metals.

Material supplies may not be the only bottleneck. Fabrication facilities also need to be considered. For instance, there are not enough high-capacity forging facilities to turn out many more gas turbine rotors using the present fabrication schedule for Timken 16-25-6. Hot-cold work in the temperature range 1200 to 1400 F is required to produce the desired high-temperature rupture strength in this material.

A possible solution for this shortage of forging facilities for turbine rotors is the use of a more easily forgeable heat treatable ferritic steel. Then forging facilities unsuitable for hot-cold working of austenitic steels could be employed. This is possible if tests prove either that the ferritic steels have ample strengths for the temperature and load conditions that exist in the present turbine designs

or design changes in the direction of lower temperatures in the turbine rotors are affected.

It is so easy to overdesign by using materials that are better than are really required for a particular operation. Both the casing and the inner liner of the combustion chambers of jet engines have been and are still being made from stainless steel or even more highly alloyed material. In recent tests searching for cheaper substitute materials for this application, aluminum-coated plain-carbon steel has shown promise. If this is successful, considerable quantities of scarce elements would be saved for more critical applications.

Much columbium-stabilized 18:8 stainless sheet is used on a jet engine and its tail pipe assembly. Columbium is a scarce, critical metal needed in certain turbine blade alloys. Every effort should be made to substitute either low-carbon low-nitrogen stainless, which requires no stabilizer, or titanium stabilized stainless for columbium-stabilized stainless so as to conserve columbium. Substitution can be made only in those applications where the high-temperature properties of the substituted materials are adequate. Even if the replacement is not actually made, forehanded research should develop all necessary changes in design, and fabrication or procedures necessary for successful use of the special low-carbon grade or Type 321, the titanium stabilized steel, in an emergency.

Research is in progress on the development of alloys and materials for service at still higher stresses and temperatures than those used in current designs. Chromium-base alloys show considerable promise. One alloy of the type containing 60 chromium, 15 iron and 25% molybdenum has shown rupture strengths at 1600 and 1800 F, about double those for the best cobalt-base alloys. Development of this alloy is still in the research stage in that all of the variations involved in its production are not understood and under control. The potential increase in properties over those of the alloys now commercially available and the saving in strategic cobalt justifies continued effort on its development.

Desired turbine operation at still higher operating temperatures suggests the consideration of ceramic materials. The need for a combination of the useful properties of a ceramic with the thermal shock resistance of a metal is apparent. Composite materials (termed ceremets or ceramals) consisting of ceramic and metallic constituents are being studied. One such ceramal consists of 80% titanium carbide in a metal matrix of 20% cobalt. Trials of this material were made in turbosuperchargers operating at inlet-gas temperatures in the range 1700 to 2200 F. This ceramal shows promise for gas turbine blade applications at relatively high temperatures for short times.

New Materials

As already mentioned, titanium has some attractive high-temperature properties. Titanium has an elastic modulus between 15,000,000 and 17,000,000 and a specific gravity around 4.5. For elastic stability at ordinary temperatures titanium and its alloys have no advantage over aluminum and magnesium alloys.

For plastic stability, presently available commercially pure titanium has no advantage over aluminum alloys on a strength-weight basis. It is probable, however, that alloys of titanium now under experimental development will be superior to aluminum alloys. A compression yield strength of about 130,000 psi. will be required to make titanium alloys equivalent to the best aluminum alloys.

Development of a commercial alloy to meet this yield-strength requirement is already in progress. In the meantime, experimental titanium alloys under development have shown tensile strengths in the range of 160,000 to 198,000 psi. and with elongations of 2 to 7%.

Titanium and its alloys are not yet available in commercial quantities. In addition to their attractive technological properties, they are particularly appealing because potential supplies are relatively abundant. At present, however, this abundance does not insure potentially low cost.

To summarize, for ordinary temperatures titanium may or may not be widely useful, depending on alloy developments. But present research looks extremely promising. In the temperature range between 600 F and 1000 F titanium is substantially superior to all other metals and alloys found so far. The corrosion resistance of titanium may make it attractive even in cases where the strength properties are not outstanding.

Besides titanium, there are some quite speculative possibilities. Consider some of the attractive features of ceramics. Enamel coatings are corrosion resistant. They may be used to protect cheap relatively abundant materials from high temperatures, thus decreasing the burden on scarce expensive materials.

As F. R. Shanley has recently pointed out, ceramics have elastic moduli in the range from 20,000,000 to 50,000,000 psi. Their densities are comparable with aluminum alloys. This combination makes for high elastic stability. There are only a few metals, rare ones at that, with elastic moduli over 30,000,000 psi. and all but one of these, beryllium, have a high density.

The compression strength of ceramics is high and, presumably, so also would be the tensile strength if some means could be found for increasing the ductility enough so that flaws would not be catastrophic. A slight increase in ductility would also improve thermal shock resistance.

Perhaps further research on the ceramets or ceramals mentioned previously may provide the clue required to eventually obtain at least a moderate amount of ductility. These materials have moduli of rupture in the order of 300,000 psi. as compared with around 27,000 psi. for ordinary ceramics.

The possibility of making useful improvements in the ductility of ceramics is quite remote. The load-carrying ability of ceramics at high temperatures, however, is a real immediate advantage. Most metals and alloys are of very little use above 2000 F, while many ceramics can still carry substantial loads at 4000 F. Furthermore, many of the ceramics are relatively abundant.

In closing, it should be emphasized that continued advancement in the development of air-borne vehicles will depend primarily on the extent to which materials engineers and designers cooperate on the solution of their mutual problems. It must also be emphasized again that we must learn to solve these problems with materials available in abundance. If the solution to a design problem involves the extensive use of a scarce material, it is worse than no solution at all, since it breeds an attitude of false security.

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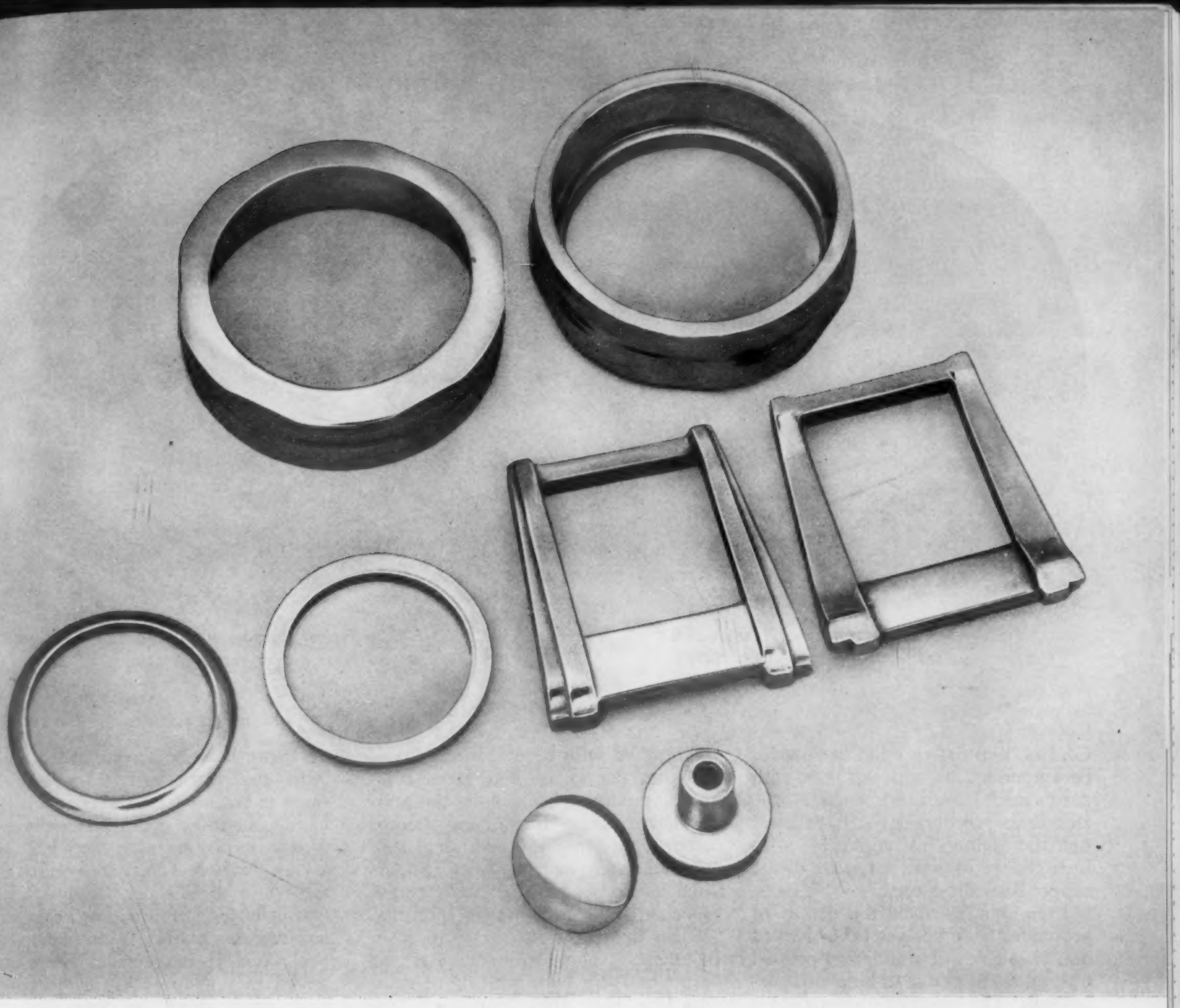


Typical examples of plated brass powder parts. The belt buckles have a copper-brass plate and the other pieces a copper-nickel-chromium plate.

How to Plate Pressed Metal Powder Parts

by **E. A. ANDERSON,** Technical Dept., The New Jersey Zinc Co.

Parts made by powder metallurgy can be successfully plated by making only relatively small changes in the plating procedures normally used on wrought parts.

● IN RECENT YEARS the plating of pressed metal powder parts has evoked considerable attention, for it is frequently desirable to improve the surface appearance or protection of these parts. As is the case with most new metal forms, the earliest stages of development in powder metallurgy were largely mechanical and, to some extent, metallurgical. However, powder metallurgy has now reached the point where protection and decoration by electrodeposited coatings must be considered, and the question of whether metal powder parts can be plated must be answered.

It has been found that most metals which can be plated in wrought form can also be plated when in the form of a pressed metal powder part. However, because of the nature of the surfaces, some difficulties have been encountered in obtaining a satisfactory plate on metal powder parts. This article surveys this plating problem as it is now known and offers some suggestions on plating practice. An exploratory program on the subject carried out by Graham, Crowley & Associates for the New Jersey Zinc

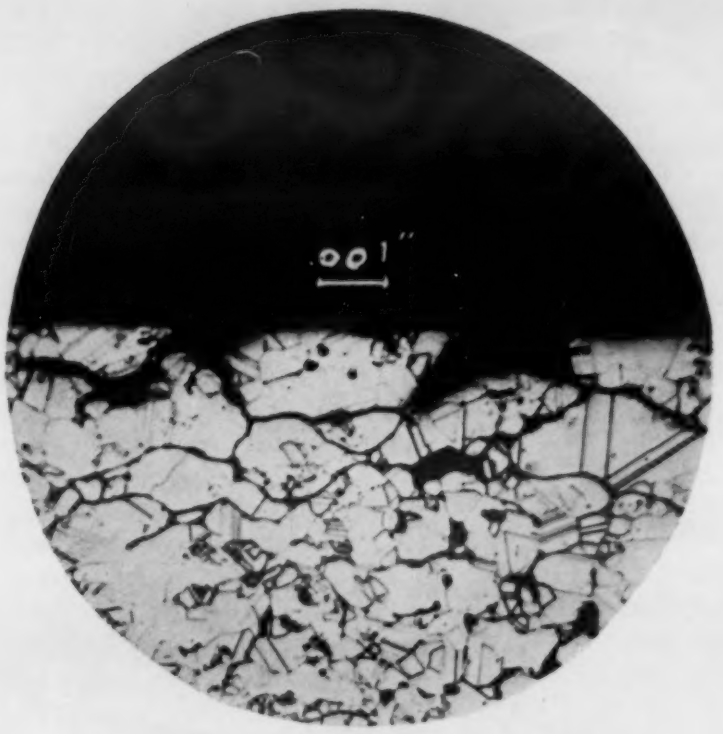


Fig. 1—Typical structure of 85 copper-15% zinc pressed brass powder part. (250X)

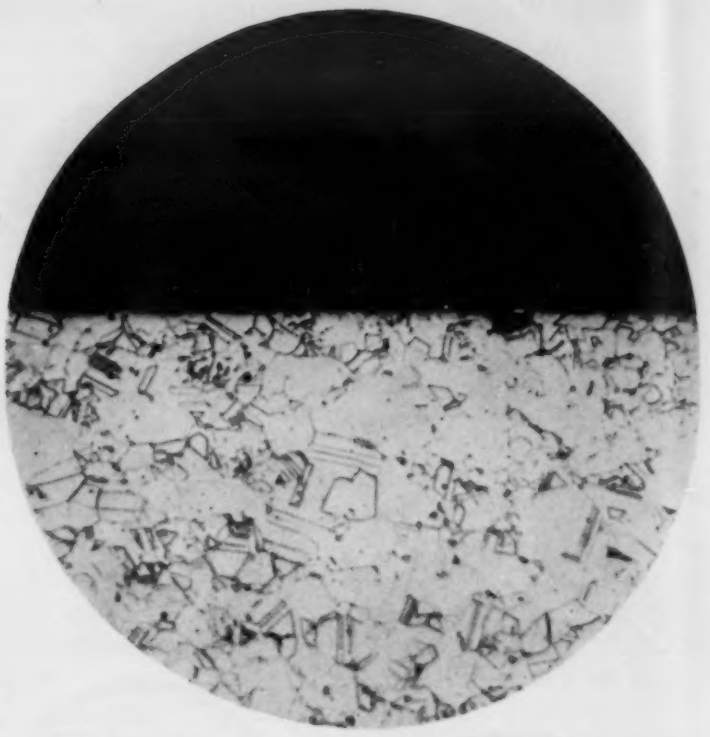


Fig. 2—Typical structure of 85 copper-15% zinc pressed brass powder part after coining. (250X)

Co. has been drawn upon heavily for background. This work was done with parts made from 85 copper-15% zinc brass powder, but it is believed that the findings are applicable with little change to most, if not all, of the copper-base alloys used.

Even though all of the details of procedure have not yet been worked out, it can now be said that pressed metal powder parts can be plated successfully. The essential observation is that after all a brass pressed metal powder part is made of brass and behaves as brass. The plating procedures which normally are used with stamped or forged brass parts are applicable to brass powder compacts with only relatively small changes required by the special characteristics of pressed metal powder parts.

In order to understand the nature and need for these deviations in plating practice, a brief description of the powder metallurgy process might be helpful. This description is based primarily on parts made from 85 copper-15% zinc brass powder. Pressed metal powder parts are made by pressing suitable metal powders in dies of appropriate shape followed by sintering in a controlled atmosphere. In many instances, these operations complete the job, and the part is placed in service without further treatment.

The powder used covers a range of particle sizes from about 100 mesh to less than 325 mesh, with the finer sizes somewhat predominant. The powder is metered into the die and compacted with a pressure of 20 to 50 tons per sq. in. The green compacts produced by simple compression are weak, brittle and porous affairs, requiring the additional step of sintering to be made useful. Sintering results in high strength and a substantial reduction in porosity. When desired, a further increase in soundness and strength can be brought about by repressing or coining the part after sintering. This operation improves the surface and results in improved dimensional control.

The few special points about the plating of pressed metal powder parts stem directly from the fact that there are pores in the surface of the parts. These normally are from 1 to 5 mils in dia. and depth, but may, on occasion, be somewhat larger and deeper. Typical cross-sections, as seen in the microscope, are shown in Figs. 1 and 2.

Mechanical Surface Preparation

Decorative plated coatings usually are produced with a high luster or a satin finish. To obtain these normally requires that the surface of the piece itself be brought to an equivalent texture before the plating operation is started. There are many ways of doing this; some involve polishing or buffing on wheels while others are carried out in rotating drums or barrels. Care must be taken in the selection of these procedures if satisfactory plating of pressed metal powder parts is to be accomplished.

In the few preliminary studies made so far, no great success has been had in obtaining good surfaces by ordinary burnishing with steel balls in a soap solution. The time required to achieve a satisfactory brightness is unusually long, and at best, the surface texture obtained is of the orange-peel type. It has further been observed that about 5% of the parts have small dents on them, which would probably result in rejection. There are other barrel polishing methods, however, using a variety of softer substances such as wood chips, sawdust, etc., sometimes mixed with abrasive, which can be used. Commercial operations involving such practices are being carried out successfully on metal powder parts today.

Buffing operations require some care in the selection of the buffing compounds. In the first place, the slightly rough texture of the surface on metal powder parts requires a preliminary mild polishing or cutting operation; otherwise the final buffed surface will appear streaky and wavy. Since the surface contains pores which, if filled with greasy binder from the buffing compound would be very difficult to clean, it is necessary to choose the compound with care. The best practice known at present involves the use of greaseless compounds. A slightly coarse type should be used first, followed by the finest type available. If very high luster is desired, it may be necessary to color the surface with a very fine lime

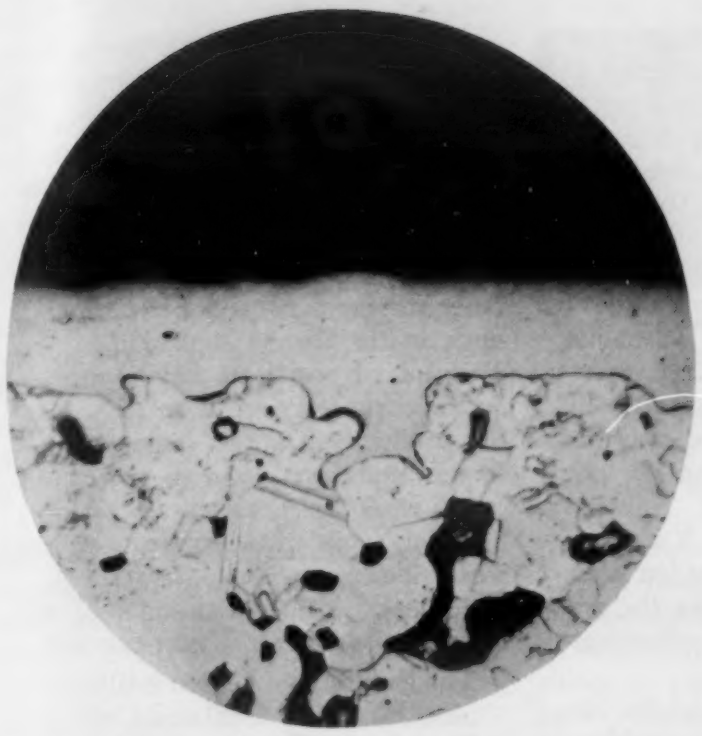


Fig. 3—Photomicrograph of nickel plated brass powder part, showing how nickel fills the pores. (500X)

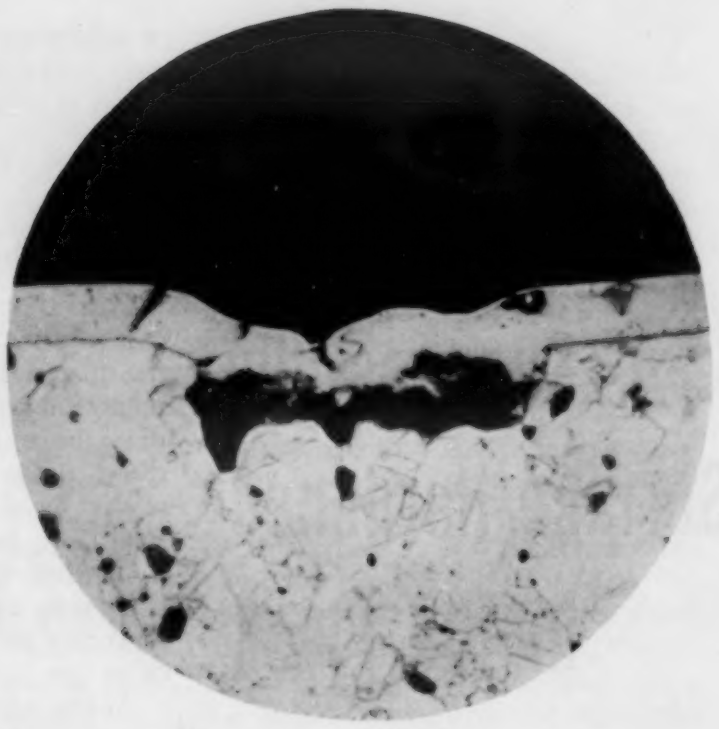


Fig. 4—Photomicrograph of nickel plated brass powder part, showing defect in plate caused by dirt in pores of the compact. (500X)

compound.

When a suitable compound has been used and the cleaning has been successful, it is quite common to observe that many, if not all, of the pores are completely filled with the electrodeposited metal. However, when grease and dirt are left in the pores, the deposit cannot enter, and defects in the plate are noted frequently immediately above such areas. Typical illustrations are shown in Fig. 3 and 4.

It is obvious that the cleaning practice must take into consideration the type of buffing compound which may be present in the pores. It is suggested that buffed parts be precleaned in a standard soak or an emulsion cleaner, followed by an anodic alkaline cleaning step.

In the absence of pits, the powder part can be plated directly with nickel. But not all burnished or buffed surfaces of pressed metal powder parts will be satisfactory for plating. The desired texture may have been achieved readily, but the surface may still show small pits whose undesirable appearance often is accentuated by the plated coating. When these pits are small in size, their effect can be minimized by applying a heavy copper coating (1 mil), which is buffed before nickel plating. When they are too large for successful use of this expedient, no reasonable practice will eliminate them, and improvements in the original surface by changes in the compacting operation will be required.

Coining or repressing after sintering seems justified in many cases either as a means of eliminating larger defects or of avoiding the extra cost of copper plating and buffing. Where such expedients are necessary, the plater and the fabricator should give joint consideration to the best answer to the problem. It is imperative that they realize that the most important cost to either of them is the overall cost of the final plated part. It is this cost which determines the competitive position of the plated pressed metal powder part.

Drag-Over

All metal objects tend to carry solutions over from one operation to the next. Since pressed metal powder parts contain fine porosity in the surface and are slightly rough in texture, solution contamination can result from failure to do a thorough rinsing job between operations. While it is true that buffing minimizes the drag-over problem, not all surfaces will be buffed. More careful rinsing between solutions will be required for pressed metal powder parts than for most wrought metal pieces.

Spotting-Out

Spotting-out is a relatively common problem in the plating industry. It takes the form of a localized staining of the plated surface resulting from the seepage of plating fluids from pores in the metal or in the plate. It is particularly noticeable on such decorative electrodeposits as copper, brass and gold, and has long been a problem with sand cast metals which often contain fine porosity in the surface. It is also a problem with pressed metal powder parts.

There are a number of well-known after plating procedures for preventing spotting-out, all of which are applicable to pressed metal powder parts. Thorough rinsing and solution neutralization and the use of water displacing liquids to remove entrained plating solution from pores are advantageous. Fortunately, the types of coating on which spotting-out is most evident are also those which require a lacquer coating to prevent general tarnishing in service. A good lacquer film will strongly minimize the spotting-out difficulty. It should be no more difficult to eliminate spotting-out on pressed metal powder parts than on any other pieces.

While there has not as yet been any large scale experience with the plating of pressed metal powder parts, it seems quite certain that, by using good normal practice with special attention to the precautions discussed above, there should be no great difficulty in producing satisfactory commercial coatings on such parts.

Reference

A. K. Graham, H. L. Pinkerton, P. A. Anderson and C. E. Reinhard. "Plating", July, 1949.

Gray Iron Parts Successfully Surface-Hardened in the Flask

by A. P. ALEXANDER,
Works Metallurgist,
International Harvester Co.

A unique method of hardening gray iron at the time of casting produces satisfactory surface hardness at lower cost than by other methods.

● WHILE GRAY IRON is an engineering material capable of developing improved properties through proper treatment, this capability is all too seldom taken advantage of. The greatest portion of the large tonnage of gray iron used in industry is used in the as-cast condition. Perhaps the main reason why hardening of cast iron is usually avoided is because the material responds to heat treatment for hardening more erratically than the engineering steels, and because most of the carbon is not readily available, making solution treatment more difficult. Yet it is sometimes possible to harden cast iron more expeditiously than the engineering steels by taking advantage of its special features.

At the Memphis Works of the International Harvester Co. the problem of hardening a gray iron casting is being solved in the foundry itself. There is nothing basically new about the solution, but the method combines two standard devices: use of a carbide-forming material as an inoculant and use of a chill in the mold, in a way that is probably unique. The results obtained by this procedure have proved to be highly satisfactory metallurgically, and the cost is lower than would be the case by any other means of hardening that has been studied.

The problem was to harden one surface of a cast iron cheek piece, which in use runs against several metal spools. The casting (as-cast) weighs about 4½ to 5 lb. Smooth finish is not required, but sufficient hardness is needed to insure wear resistance. Gray iron was the logical material choice to satisfy all other requirements.

It was found that the iron—in this case a No. "20" gray iron—would not flame-harden readily to the desired hardness. Also, it was found that there was insufficient combined carbon to permit induction hardening in one pass. Deep hardening was undesirable because of the resulting embrittlement of the piece. It was undesirable also to change the composition of the iron in the cupola, as these pieces were a small part of the production of this large foundry. It was therefore decided to get adequate wear resistance by obtaining a 5/32-in. zone of white iron on the wear side.

Some of the constituents of the inoculated gray iron being cast were:

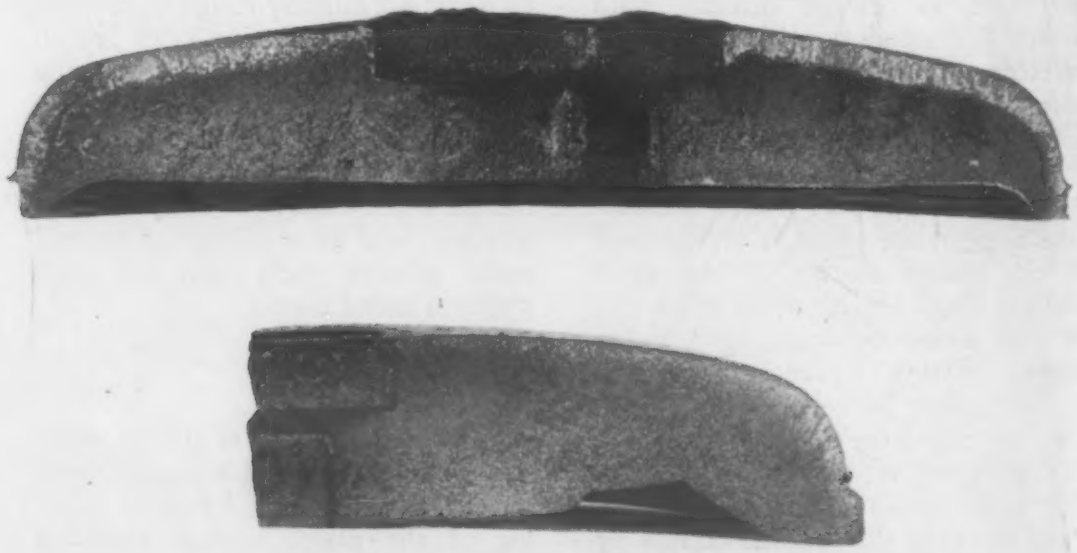
Total carbon	3.20 to 3.40%
Silicon	2.00 to 2.15%
Phosphorus	0.030 to 0.050% max.

Average physical properties for the material would be:

Tensile strength	35,000 psi.
Transverse strength	3000 to 4200 psi.
Deflection	12 to 15%
Hardness	190 to 215 Bhn.

Development of Hardening Procedure

The cheek pieces were cast two to the flask. Use of a chill in the mold gave hardness results below the requirement. Tellurium powder, an extremely active carbide-former, was next added to the ladle just before pouring. It was found that the tellurium burned out rapidly, and that use of enough tellurium in the ladle to give sufficient hardness to the cast metal in sand molds, without the chill, failed to localize the hardening

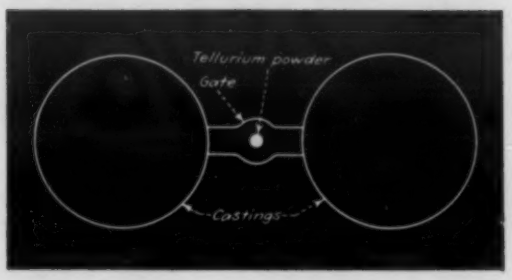


Cross sections of hardened cheek piece showing a uniform, sharply localized zinc on top side. (Courtesy International Harvester Co.)

effect to the desired degree. It was with the use of tellurium in the molten metal and a chill in the mold that best results were obtained.

The matter of satisfactory and economical application of the tellurium was handled by experimenting with the casting process until a means was found to obtain a sharply localized zone of white iron of the required depth along the wear side of the casting. Painting tellurium on the mold or on the chill gave good results, but castings lacked uniformity.

The method finally hit upon was to place a measured quantity of tellurium powder in a pocket in the mold, at the gate, so that the hot metal would pick it up and dissolve it as it rushed into the mold cavity, and at the same time would cool before the tellurium could be burned away. The only metal affected by the tellurium is the gray iron in the cast



Sketch showing location of tellurium in pocket in the gates.

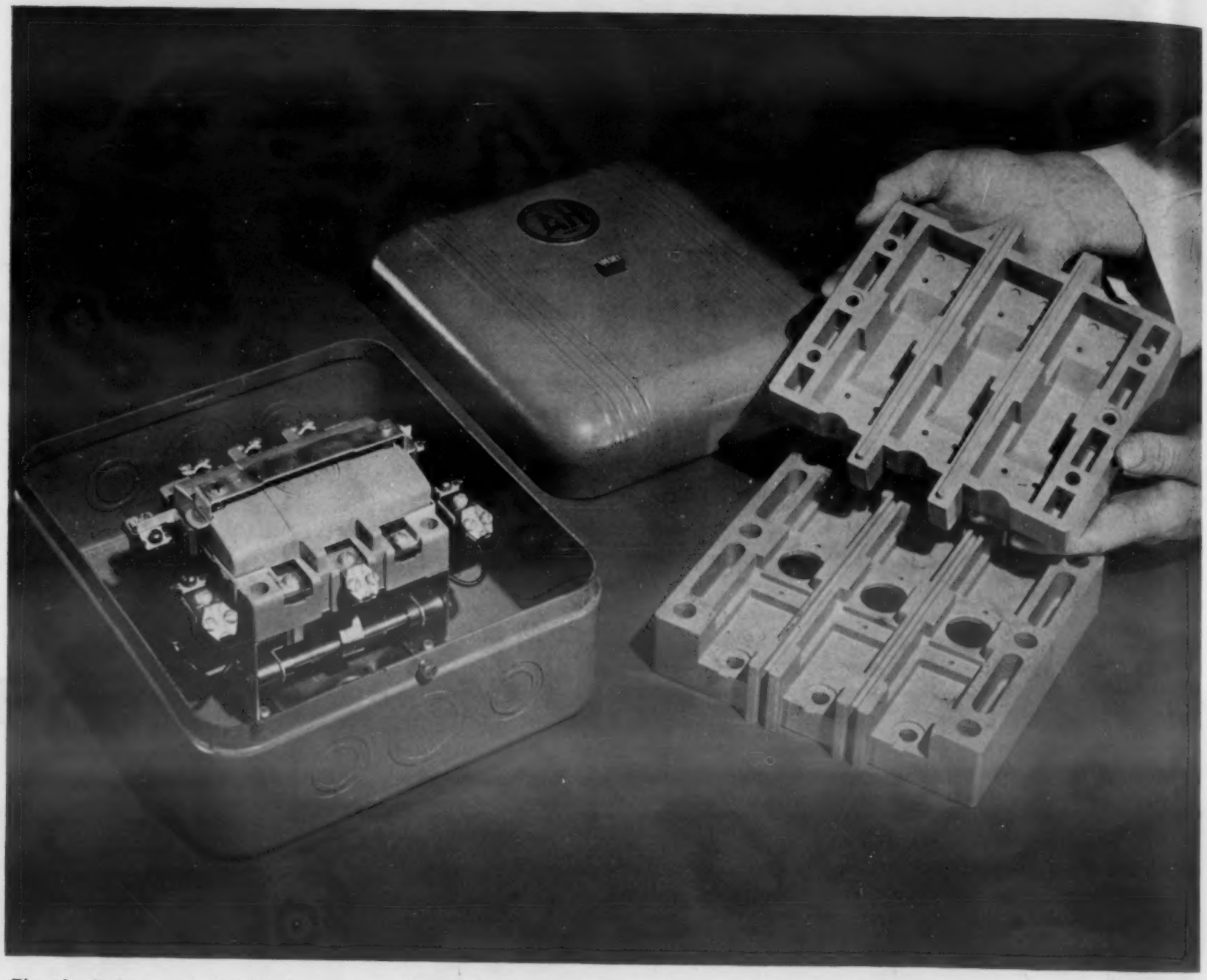
piece and the metal remaining in the gate, thus giving most efficient utilization of the inoculant. The metal standing in the sprue takes up practically nothing from the pocket of carbide-forming material.

Experimentation with the quantity of tellurium to be used finally resulted in setting 4½ to 5 gm. as the best amount. This is about 0.11%, based upon the weight of gray iron in the two castings, and ignoring any loss in burning away or in metal in the sprue.

Use of the tellurium involves no difficulty either in adding it to the metal or in reuse of the scrap. Tellurium burns away completely in the cupola, so that any traces of the inoculant that might be carried back to the cupola in sprue-sticks or in scrapped work disappears without affecting the melt in any way. Placing of the powder in the mold is done by measuring out a small dipperful of the powder into a small depression at the foot of the sprue, and requires only a few seconds and no skill when the quantities have once been fixed upon.

The castings as they come from shake-out possess a uniform, sharply localized zone of white iron along the wear surface, with the remainder of the piece a typical gray cast iron. They have given completely satisfactory service.

Local hardening can be accomplished in the flask by use of chills and by placing tellurium powder in pocket of mold.



The plastic base and electrical components of a magnetic motor starter, shown with molded plastic hood and steel cover. Arc resistance is an essential here. (Courtesy Arrow-Hart & Hegeman)

Fast-Curing Thermosetting Plastic Makes Possible High Production Rates

by **KENNETH ROSE**, Western Editor, Materials & Methods

High arc resistance and dimensional stability, and production rates that compare with injection-molded thermoplastics, are among the attractive properties of this mineral-filled molding powder.

• A NEW ALKYD molding compound with a remarkably short curing cycle was introduced last fall at the Annual Plastics Exposition (see MATERIALS & METHODS, Nov. 1948, p. 76). Since then considerable data on its performance in service have been obtained which now makes possible a more complete evaluation of the material.

Some of the properties claimed for this alkyd resin are exceptionally high arc resistance, dimensional stability, and elimination of tracking when exposed to the electric arc. The molding properties are extremely interesting to production-minded engineers, because they make possible the production of molded thermosets with smaller equipment than the ordinary compression molding machine at a rate that compares with that of the injection molded thermoplastics. The

new molding compound can be cured and removed from the press within a matter of seconds, as compared to minutes with the accepted thermosetting resins. The material is available as a mineral-filled molding powder only, and is designated Plaskon Alkyd molding compound by its producers, Plaskon Div., Libbey-Owens-Ford Glass Co.

Its arc resistance, the highest of any commercially available molding plastic, seems to indicate that it should find ready acceptance in the electrical industry for certain purposes, and the low molding pressures and short cure time seems to offer a chance for very high production rates by the fabricator. While strength is rather low, as is the case with mineral-filled plastics in general, it seems to be ample for most purposes not requiring the highest impact and tensile properties.

The molding properties of this alkyd resin are such that a readjustment of both the operation of the press and the thinking of the molder are required. Field tests for two years before release of the material to the industry generally had shown something of the potentialities of the molding alkyd in fast-acting presses, and something of its disadvantages when not properly used. For example, with a slow-closing press the cure might progress to the danger point before the dies squeeze the plastic into the crevices of the mold cavity.

Successfully Used in Industry

Facts accumulated from recent production runs on a variety of pieces and in shops operating under different conditions permits an appraisal of the material in the light of its use by industry. It seems likely that for the present the molding alkyd will find its greatest use in the electrical industry, though production of types of alkyds other than the mineral-filled molding material would widen its scope of use considerably. Electrical properties are good generally, and arc resistance has proved to be everything predicted for it. In some tests, however, which simulate extreme service conditions such as encountered in the tropics, the original material has shown some loss or surface resistivity. Modifications of the compound, now being evaluated, appear to eliminate this shortcoming. Dimensional stability is excellent, and electrical properties under normal conditions are satisfactory.

It is in molding performance that the alkyd has achieved some of its outstanding successes. The material is molded at temperatures of about 300 to 310 F, and upon reaching the molding temperature it softens for a few seconds to a putty-like consistency. It is essential that the press close quickly enough to force the plastic into every part of the die cavity during this stage, which lasts only about 2 sec. The material then sets up very rapidly, and cure is sufficiently advanced a few seconds later to remove the part from the mold. During the plastic stage only a few hundred psi. pressure are required to fill out the cavity, and the presses can therefore be quite small in size. Dies can be made smaller and lighter also.

Production results, confirming the estimates made when the material was introduced, show the following lines of economy for the molding compound:

(1) With special equipment, the alkyd can be molded at its maximum production rate. Economies here are two-fold: (a) production rates are many times those for other molded thermosets, and surpass the rates obtainable with injection-molded thermoplastics; (b) the equipment is much smaller, lighter, and more economical to operate. It can be made fully automatic, thus reducing labor costs.

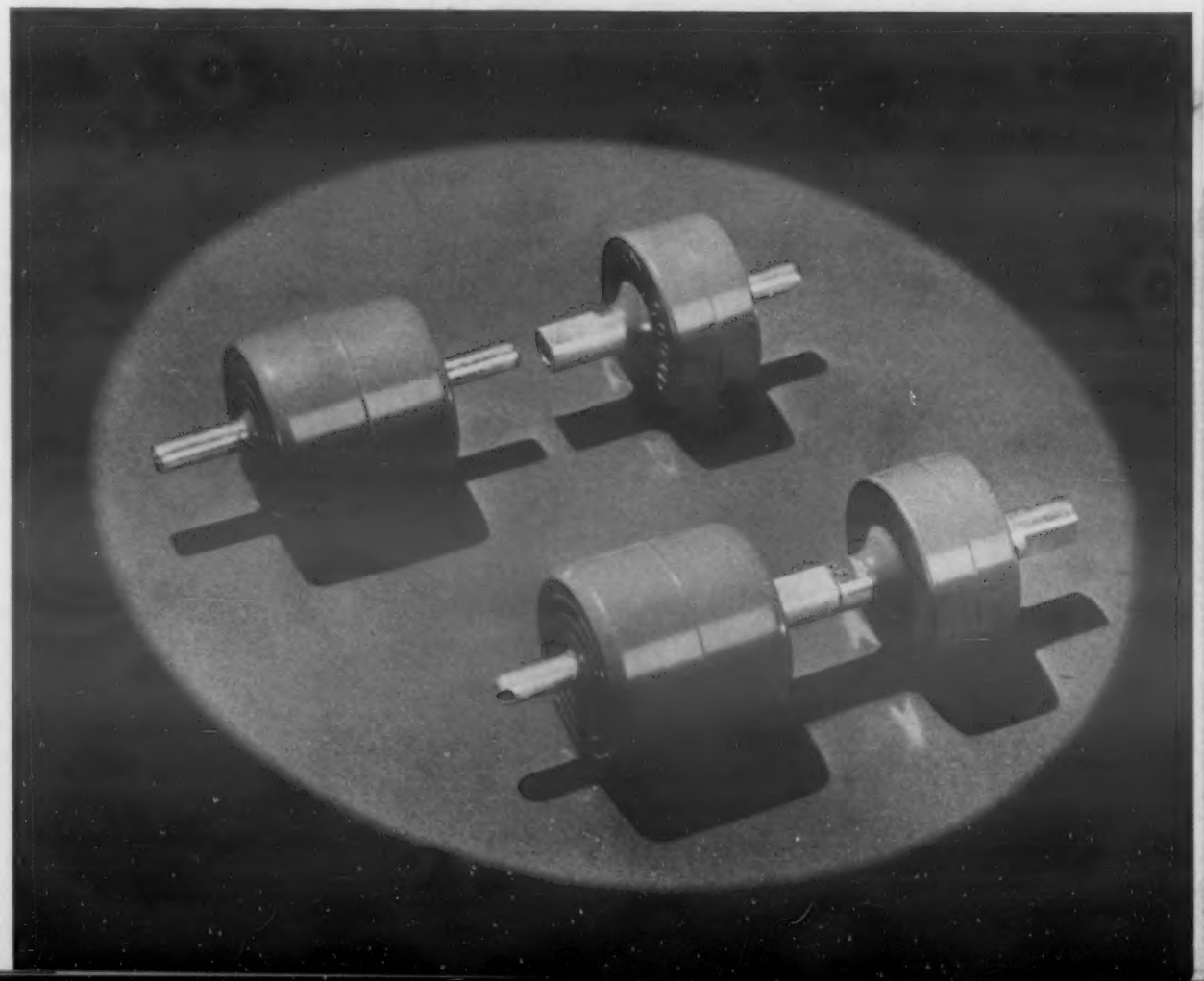
(2) With the quick-acting hydraulic presses, production rates can be increased over conventional phenolic operations, the amount of increase depending upon the abilities of the press. It is here assumed that the press is capable of quick closing, so that the alkyd can be successfully molded and that it will be built for the heavier service necessary with thermosets requiring high pressures for satisfactory cure. While such equipment does not realize the fullest economies of the material, it is sometimes necessary to use it because it is available immediately.

The low pressures required make possible the use of pneumatically-driven rams, with lighter construction throughout, instead of the heavily constructed hydraulic presses with accumulators, pumps, etc. Small, quick-acting hydraulic presses are suitable also. Molds can be simple single-cavity flash molds rather than the multicavity molds with heavy steel walls. Some of these economies have been evaluated and summarized in the accompanying table by Plaskon engineers, using as the basis for comparison equal production by the light bench-type press with electrical controls and by the heavy hydraulic press with multicavity molds running other thermosets.

Typical Applications

Arrow-Hart & Hegeman Electric Co. is molding components for a magnetic motor starter from the alkyd molding compound. Two of

Television power supply is filtered through these capacitors. Shells are of molded alkyd resin. (Courtesy Centralab Div., Globe Union, Inc.)

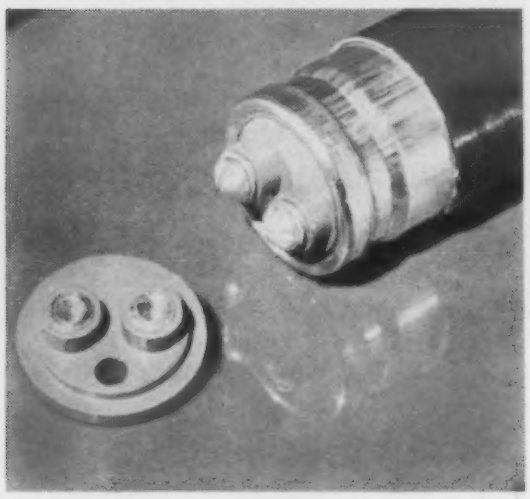


Economies Obtained with New Alkyd Plastic

	Alkyd Molding Machine	Other Thermoset in Hydraulic Press
Cost of Machine	$1000, approx.	$4000, approx.
Floor Space Required	9 sq. ft.	22 sq. ft.
Mold Used	Single cavity, cost $500	Multicavity, cost $2000
Labor	Fully automatic, unskilled operator for several machines	Skilled operator required

these are paired pieces on which the electrical contacts are mounted; they are required to have excellent resistance against tracking by the arc formed between the contacts each time the motor is started or stopped. The pieces, hood and base, are made in four sizes, the heaviest weighing 2¾ lb. for the hood and 3 lb. for the base, the next 1 lb. and 1¼ lb., respectively, the next smaller ½ lb. and ⅜ lb., and the smallest ¼ lb. and 5/16 lb. Wall thicknesses for the heaviest piece are nearly an inch.

The sealing disk for an electrolytic starting capacitor used in a motor starter uses the fast-cycle molding resin. (Courtesy Sangamo Electric Co.)



Pieces similar to these had been produced from a phenolic formulation. The heavy wall sections required made cure time rather long. The largest pieces were cured for about 20 min. When produced in the alkyd material the molding cycle was shortened to 3 to 4 min. The smallest pair of pieces were produced by transfer molding, while compression molding was used for all the others.

High dimensional stability was also a factor in the design of these motor starter components. Here the alkyd molding compound met all requirements satisfactorily. Resistance to heat was required to be high also.

Standard Coil Products Co. is making a television tuner, in which dimensional stability must be of the highest order. Tolerances for the alkyd molded segments that form the barrel of the tuner are as close as 0.0005 in. A low loss factor is another requirement. Of course, high production is desirable also.

The tuner components are strips of plastic in which contact pins are set. One strip, with contacts for the oscillator board, contains six perforations for contact pins, while the strip holding the antenna board contacts has five perforations. Both strips have a bracket molded at either end to hold a tiny winding. The oscillator board strip is 2⅛ in. long and ⅝ in. wide, and the antenna board strip is 1⅞ in. long and of the same width. They weigh about ⅓ oz. each.

An eight-cavity mold is used, and molding pressure is unusually high for the alkyd material—4,000 psi. Cure time is 20 sec. Production is about 100 shots per hr., though a rate of 120 shots per hr. was maintained for a period at one time during manufacture.

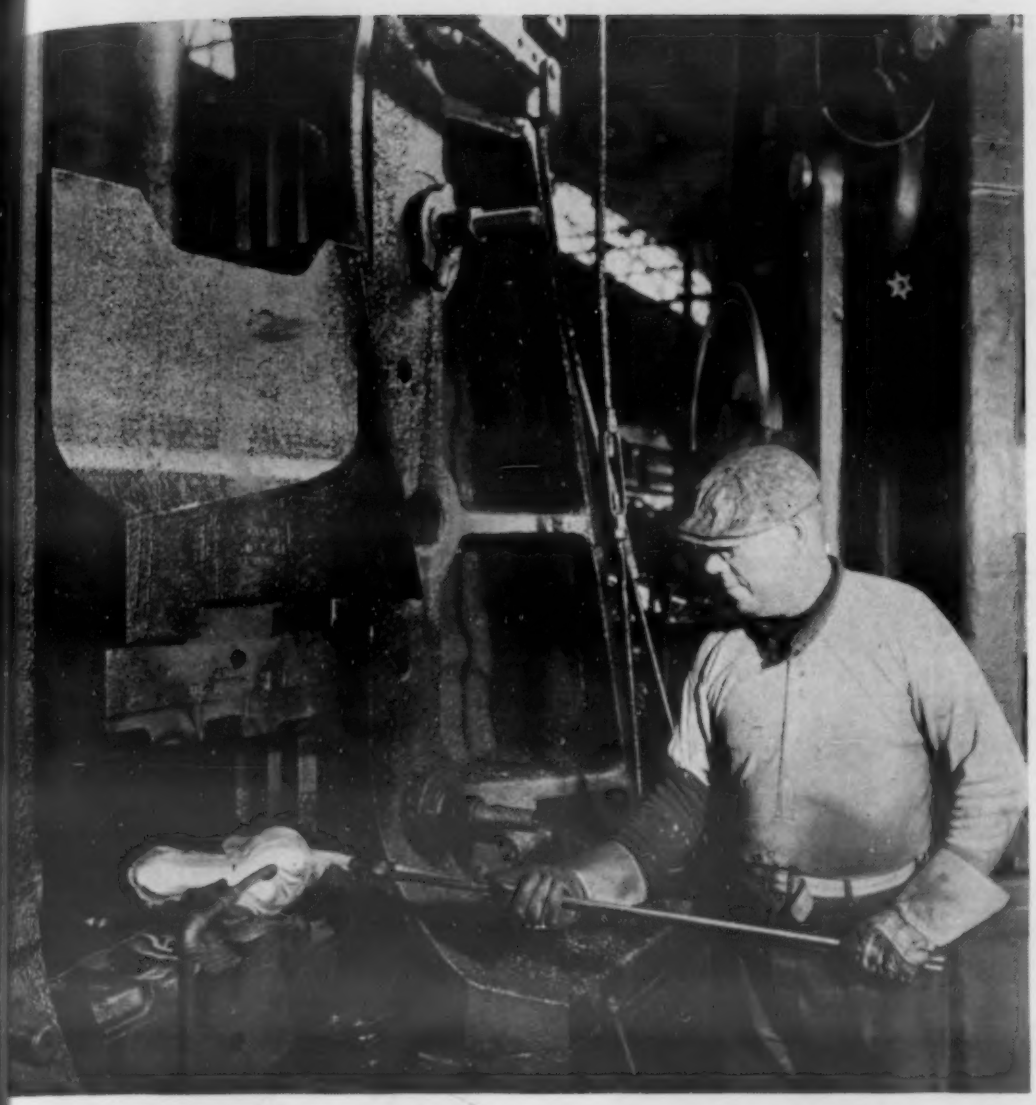
Extreme accuracy is necessary because the tuner, through the contact pins and coil winding in each segment, selects the television channel by making the proper group of contacts. The tuner consists of 12 pairs of strips with a total of 132 silver contact pins, each of which must make perfect contact. Variations in the tuner would bring a distorted image to the screen, or no image at all. The contacts are soldered into place, with solder in direct contact with the plastic. No adverse effect on the plastic has been noted.

Another television item is the capacitor that forms part of the power supply filter. These capacitors are made by the Centralab Div., Globe Union, and the shells are molded of the alkyd compound. A metal insert is used in the mold, and the plastic is required to adhere closely to a ceramic part of the capacitor. Electrical properties must be such as to include: low loss, good arc resistance, insulation resistance and dielectric strength to prevent flashover under high voltage. The molded shell, with metal insert, weighs about 1 oz. The alkyd material meets both electrical and mechanical requirements, and provides a high rate of production as well.

A terminal block for a time switch, made by the Sangamo Electric Co., and a contact arm for the same switch are also being produced of the new alkyd resin. They are small pieces, weighing only ⅞ oz. and ⅛ oz., respectively. In each case the piece must possess superior resistance to tracking by any arc that might be formed when contact is made or broken by the switch. The alkyd performs satisfactorily, and permits molding these small pieces at a rate that makes them attractive costwise.

In the same classification is a sealing disk for a motor starting capacitor, made by the same company. This piece weighs only ½ oz. Electrical properties and low-cost fabrication possibilities were the deciding factors in the selection of the alkyd molding compound as the material to be used.

Small parts like this terminal block in a timing switch must be low in cost, high in electrical properties. Alkyd resin meets requirements. (Courtesy Sangamo Electric Co.)



Where production is great enough to repay die cost, drop forging is economical. (Courtesy International Harvester Co.)

When to Use Steel Drop Forgings for Stressed Parts

by **KENNETH ROSE**, Western Editor, Materials & Methods

Redesigning highly stressed parts for drop forging often results in closer tolerances and reduced weight while still meeting the same strength requirements.

● WHILE A PRIMARY function of the materials engineer is the selection of the material best suited for a certain purpose, after having decided upon the proper material he frequently finds himself with the problem of choosing the method of fabrication. This ties in closely with the problem of choosing the material itself. For example, costs associated with the fabricating method can be a deciding factor in making a choice between two materials that otherwise would meet requirements upon an almost equal basis.

When strength requirements and cost indicate steel as a likely material for a proposed part, forging will probably be considered as a possible means of fabrication. If high production be desirable, and the quantities will repay die costs, and if the size is not too large, drop forging will probably be most economical.

Advantages and Limitations of Drop Forging

Some of the considerations involved in drop forging as a fabricating method are:

(1) For highly stressed parts, forging would probably be selected because of its uniformity of quality. The importance of uniformity in the properties required has been shown graphically by the newer methods of statistical control. It has long been recognized by engineers, however, as one of the unknown factors that must be covered by a "factor of safety." Thus, if a piece has been designed to meet a stress of 35,000 lb., and most of the pieces withstand loading of 50,000 lb., but 5% fail at 30,000 lb., the engineer must (a) raise the strength of all of the pieces until statistical control methods show that even the weakest will possess adequate strength; (b) eliminate all of the failing pieces by some such means as 100% proof testing; or (c) improve the product so that strength will be more uniform. In this last case a switch to forging might be decided upon.

(2) A weight saving is frequently accomplished by a switch to forging. If desired, the assurance that strength requirements will be met by all of the pieces may be translated into lighter weight. Grain size and directional properties are other factors influencing possible lightening of forged pieces. Ribs and deep fillets in castings, required to compensate for cooling stresses, can be eliminated in forgings.

(3) Forged dimensions can be held to close tolerances. With a little care, dimensions can be held within about 1/64 in., while tolerances of 0.003 to 0.004 in. are held with precise work. Producing forged pieces to such limits is expensive, however, and requires skillful handling of both the metal and the equipment. A cold restriking is one of the usual means of obtaining close tolerances. With

soft metals, a cold coining operation will produce accurately dimensioned parts.

(4) Directional properties provide advantages. Proper design of dies and of the blank can be used to get a preferential orientation of grain in the metal. It is not entirely a matter of fibrous structure as in wrought iron, where elongated slag particles show the directional working of the metal. Directional properties in forged steel are partly a result of grain flow, and ferrite especially shows the orientation. Ductility and fatigue resistance are better along the line of grain flow.

(5) Forging leaves a rather coarse structure. While finer than a cast structure, the forged structure is improved by a normalizing treatment for grain refinement. The normalizing treatment is customary for parts that will be highly stressed, such as aircraft parts or ordnance pieces; for many less critical purposes forgings are used in the as-forged condition.

(6) Forgings are limited as to shape. While castings can use cores to produce hollow sections, forgings must be of such shape that they can be withdrawn from the dies. This limitation can be overcome in some pieces by combining drop forging with piercing, or with some other operation. Forging a piece in sections and subsequently welding them together is another method that has successfully produced hollow forms.

(7) Drop forgings are limited as to size. Closed die work imposes a practical limitation in the size of the dies and of the hammer.

From the above discussion it is evident that the principal advantages of drop forged steel parts over steel fabricated by other means are that comparatively heavy sections can be formed to reasonably close tolerances at a high production rate with uniformly high physical properties. In comparison, pressed metal processes are usually concerned with steel in relatively thin sections. Welding is a high production process only under sharply limited conditions. Steel castings are not produced with properties so uniform that minimum guaranteed physical properties can be fixed close to the average test results.

The journal box, shown here, for 70-ton hopper cars is forged in two halves, then welded together. (Courtesy Timken Roller Bearing Co., Inc.)

Typical Uses of Drop Forgings

An excellent example of the utilization of the properties of forged steel, and of overcoming one of the limitations of the forging process by ingenious design, is the development of the journal box for freight cars. Because of the gruelling service to which railway freight cars are subjected, this part of the car was made as a heavy steel casting. With the development of higher-speed freight trains, and more severe service conditions generally, railroad engineers began to examine the car design more critically in the light of these new service conditions. A point of weakness was the plain friction bearing. It is one of the parts most requiring inspection, and one of the limiting factors in train speed under load. The railroads would like to run cars through terminal points without stopping for a complete train inspection, and to take full advantage of the higher speeds of the diesel locomotive. For these reasons the car bearings were studied.

The adoption of a roller bearing in place of the sleeve bearing to reduce friction was part of the solution. A forged steel journal housing was developed in conjunction with the redesign. One style housing is made from steel plate, using SAE 1040 steel to develop high strength while keeping weight down. To circumvent the difficulties involved in forging hollow pieces, the housing was designed in two halves, and the forgings were welded together.

To form the top half, a 4½-in. square plate weighing 47 lb. is used for the blank. This is blocked on a steam hammer, trimmed, reheated, and forged on a 6000-lb. steam hammer, then trimmed again. Final hot forming at 1600 F completes the piece. It is then shot blasted in preparation for welding. The weight of the finished half is 38 lb.

The bottom half starts as a 4 by 4⅛-in. steel blank weighing 30 lb. It is first forged on a steam hammer, trimmed, reheated, and then restruck for size at 1800 F. Following a blast cleaning, the piece is ready for welding. It has been reduced in weight to 22 lb.

When the two halves are to be joined by flash welding, an 800-kva. machine is used. About ⅝ in. of stock is burned away on each side in joining the 7½-sq.-in. area. The forgings are upset at 150,000 psi. to produce a forge weld. Submerged arc welding is being tried as an alternative, with the saving of the 1¼ in. of metal

The yoke shown at right is a forging and is lighter but stronger than the steel casting at left. (Courtesy Interstate Drop Forge Co.)

ost in the flash welding as a possible dvantage.

In another type of journal housing SAE 1030 steel is used, and the piece s made in two forged halves and a tamped cover, all welded together. As with the first-mentioned style, the lash must be chipped off, preferably while the metal is still plastic, and the weldment stress relieved at 1100 F. In addition to the advantages generally obtained by use of forged metal where applicable, savings were made by lowering the number of rejected pieces in production of these forged journal housings. Inspection costs were lower, also.

A typical example showing how the form of a piece influences its production costs when several alternate fabricating methods are under consideration is that of a track shoe for a tractor. It was originally made as a steel casting. Because its simple form was more economical to produce as a forging, and the forged metal gave a better response in heat treating, it was converted to that method of production. Further study of fabricating possibilities led to its redesign as a hot rolled item. On the other hand, a drive sprocket in the same machine is still produced as a steel casting, as a cost study indicated that if produced as a forging it would be difficult to drive the metal into the tooth cavities in the die. This would result in high die costs through short die life.

Another case involves a clutch yoke for a gasoline engine which had been produced as a steel casting. Conversion to a drop forging was decided upon, and after the forged yokes had been produced the results were studied. Some of the advantages were:

(1) A saving of material was accomplished. This was partly due to the lighter weight of the finished forged piece, and the reduction of excess metal in the rough piece due to forging to closer tolerances. The weight was reduced 22% in the changeover.

(2) Rejects were practically eliminated. Pieces scrapped because of structural defects had been another item of material loss, and the considerable reduction of rejects represented an important saving.

(3) Machining and inspection costs were lowered. The cost of machining was cut when such defects as trapped sand and hard spots were no longer encountered. A corollary saving resulted from reduction of concealed defects, which, when discovered in the course of machining, meant the loss of the piece and of the work put into it.

(4) There was an improvement in the quality of the finished piece. Strength was greater in spite of the lighter weight of the forged piece. Greater uniformity of the parts was translated into greater dependability in service.

Illustrating the fact that the method of production best suited to a given article depends upon various factors in materials selection and in processing is the case of alloy steel connecting links for use with wire rope or chain. These links are used in draglines, slings and machinery items, and are required to withstand heavy stresses. While the links are produced as drop forgings in the smaller sizes, the larger sizes are made as alloy steel castings. Study of the processing problems had shown that die cost for the large sizes would be excessive. These large pieces weigh about 40 to 80 lb. each. With the same links, it was found that several of the smaller sizes would be useful in a chromium-nickel-molybdenum alloy. In sizes weighing from about 8 to 15 lb. these were produced as castings also.

When using unusual alloy steels there is sometimes an advantage in making up the analysis in a small batch in an electric furnace and casting the parts rather than to attempt to obtain sheet, bar or rod stock for forging. This depends upon the quantity requirements of the material, and upon the facilities available for making up batches of unusual and nonstandard composition.

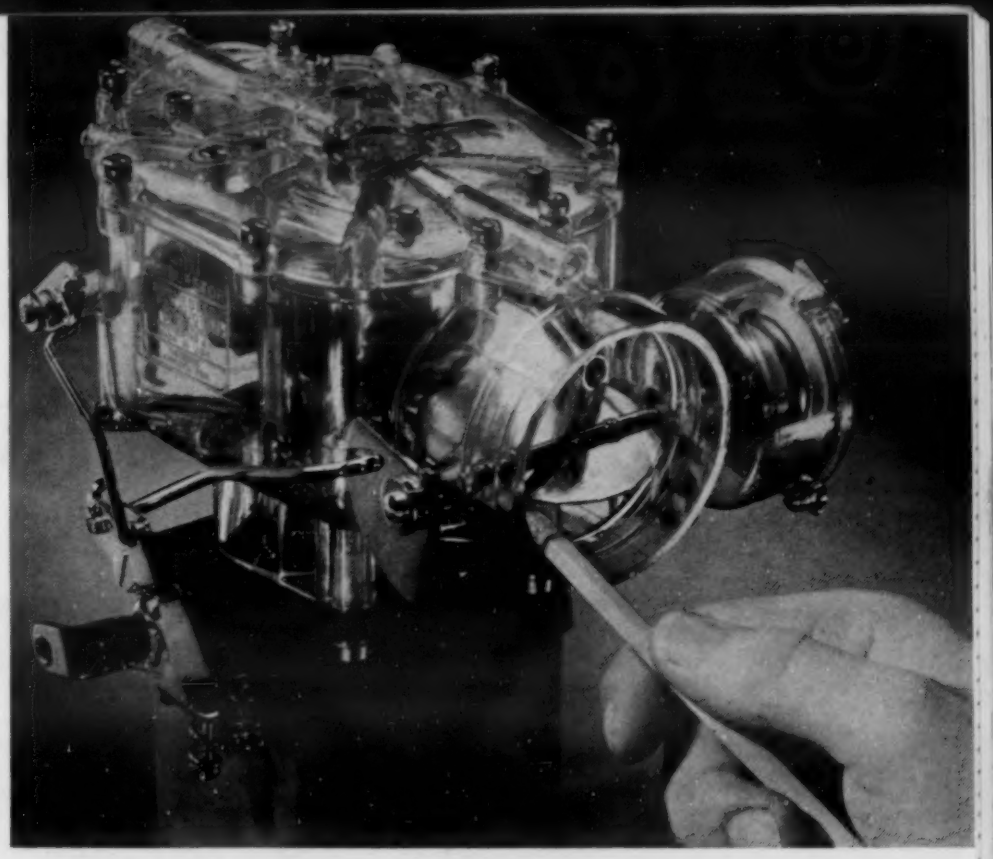
Materials at Work

Here is materials engineering in action . . .
New materials in their intended uses . . .
Older, basic materials in new applications . . .

HIGH-STRENGTH STEEL TRAILER ***Shown here under construction, this truck trailer haulaway rig for the transport of automobiles will weigh approximately 7000 lb. when completed. Built for maximum structural strength, rigidity and resistance to fatigue, the trailer is made of high-strength steel. Had mild steel of equivalent strength been used, the weight of the trailer would have exceeded 9000 lb. Thus, approximately one ton of deadweight has been eliminated by use of high-strength steel. On this unit, the top and bottom tracks, and the bottom roll side sheets are made of Jones & Laughlin Otiscoloy steel sheet.***

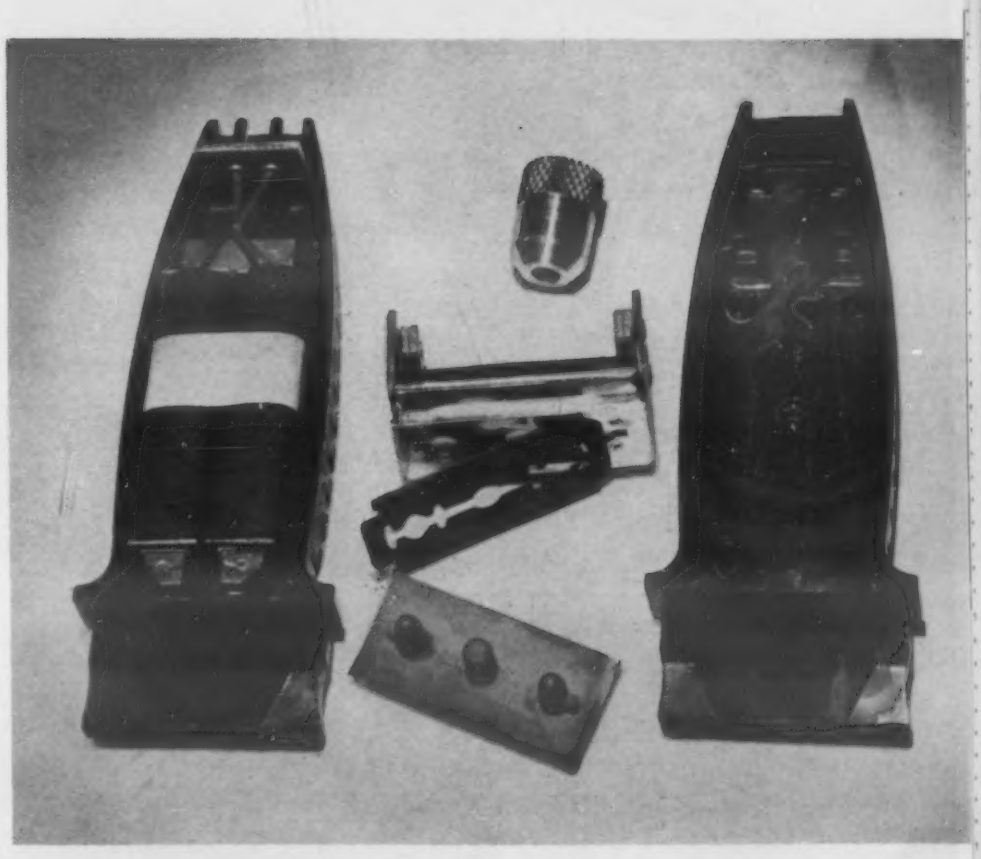
TRANSPARENT PLASTIC CARBURETORS

Visual models of automobile carburetors are injection molded by Ontario Plastics, Inc. of clear, transparent cellulose acetate butyrate Tenite in the same dies as are used for actual metal units. The plastic carburetor consists of seven separate parts, molded under high heat and pressure. Since the plastic has good dimensional stability and can be molded to close tolerances, accurate fit is assured. The clear plastic provides excellent visibility of controls and gas and air lines in choke, idling, full throttle, and cruising positions. There is minimum danger of breakage, and the light weight of the models provides easy portability for demonstration purposes.



PLASTICS SHAVER HOUSING

The shatter- and shock-proof features of the Collins Vibrazor housing distinguish it from the housings or cases of conventional electric shavers. Injection molded in two identical halves by the American Insulator Corp., the ethyl cellulose case can be safely immersed in water, dropped, jarred, or otherwise misused without damage. The halves are bonded together with ketone cement to form a water-tight enclosure for the electromagnetic unit, which provides driving force for the razor. Cutting head mounts in open end of housing, held by springs bearing against molded indents. In operation, permanent magnet embedded in cylindrical knurled nut which fastens parts in head assembly is actuated by drive coil, causing blade to vibrate on copper springs mounting the blade platform. Photo courtesy Hercules Powder Co.



ALUMINUM AND PLASTIC SANDER

Designed for a variety of buffing, sanding and polishing operations, this new tool, a product of the American Floor Surfacing Machine Co., has a heavy die-cast aluminum frame, helical spur gears, and a 1600-rpm. G.E. motor that operates on 110-v. current. The cellulose acetate handles, molded by the American Phenolic Corp., mark one of the first uses of a thermoplastic material for heavy-duty electrical tools. Both top handle, with molded-in ventilating shield for motor, and side knob are produced in a fawn-gray, flame-resistant formulation that withstands rough usage and provides an attractive color and texture contrast with the dull-finished aluminum motor housing and frame. Photo courtesy Hercules Powder Co.

Materials at Work

ALL-ALUMINUM INBOARD RUNABOUT *Sheathed with 52S aluminum alloy 0.051-in. thick, this 15-ft. speedboat is a product of the Paragon Marine Construction Co. The hull is riveted throughout and utilizes a zinc chromate tape and an aluminastic as a gasket sealer in the seams. Hull construction is of the semi-monocoque type incorporating four longitudinal I-beams and no transverse ribs. The bottom area is composed of a lamination of three layers, totalling a thickness of over 5/16 of an in. Dry rot, decay, water absorption, painting, caulking and varnishing are eliminated. Available power plants range from 25 to 60 h.p.*

BONDED SILICONE RUBBER *The strength and suitability of silicone rubber for high pressure gasket and diaphragm applications is improved when it is bonded to glass fibers, asbestos, wool or cotton. Produced by the Stalwart Rubber Co., such bonds have been used for both molded and die-cut parts. When joined to glass fibers or asbestos, the versatile synthetic rubber will remain unaffected at temperatures ranging from minus 160 to more than 400 F. Silicone rubber bonded to wool is suitable for applications involving constant temperatures up to 300 F and intermittent temperatures to 400 F. Bonds of the rubber to cotton will withstand temperatures to 250 F. Parts fabricated from any of these bonded materials will not turn to carbon at the respective maximum heats, and will withstand permanent compression, prolonged weathering, and hot lubricating oils.*

●

CORROSION RESISTANT AIR VALVE *Utilizing a double solenoid pilot valve readily adapted to fluid pilot actuation if desired, this high-speed air valve, produced by the Hanna Engineering Works, requires only momentary current for operation. High strength cast iron is used for the valve body and manifold, nickel cast iron for the sleeve and spool, and a magnesium alloy for the oscillating "tiller" of the pilot valve. Stainless steel and phosphor bronze are used for disks, and Neoprene rubber for shock-resistant packing at the disks. The four-way valve can be disassembled without breaking any pipe connections.*

Electroplaters Discuss Consumer's Problems at 36th Annual Meeting

THE 36TH ANNUAL meeting of the American Electroplaters' Society attracted more than 1,000 members and guests to the Hotel Schroeder, Milwaukee, Wisc., during the last week in June. The technical sessions of the meeting were in the nature of educational lectures, with many designed to discuss the needs and problems of the ultimate consumer of plated products.

No commercial exhibits were held this year, although samples of various plated goods were shown through the sponsorship of various chapters of the Society. In addition, some companies prominent in the plating field had private exhibits in their hotel rooms.

Highlights of the social program were the annual banquet and the yearly golf tournament sponsored by the International Fellowship Club. Plant visits included tours of the roller skate department of Globe-Union, Inc., the automobile body assembly line of Nash-Kelvinator Corp., and the General Electric X-Ray Div. works.

Final business of the annual meeting was the election of officers. In all except one office, the newcomers stepped up from one rank lower. New officers and their positions are: President, A. W. Logozzo, Nutmeg Chrome Corp., Hartford; first vice president, W. J. Neill, Columbus Metal Products, Inc., Columbus; second vice president, C. F. Nixon, Ternstedt Div., General Motors Corp., Detroit; and, third vice president, Franklyn J. MacStoker, Farrand Optical Co., New York. Mr. MacStoker is the newest officer. S. S. Johnston, Weirton Steel Co., is the immediate past president of the organization.

The technical program was scheduled over a four-day period, with subject matter ranging from papers on the consumer's views on plated products to the highly technical problems being investigated under A.E.S. research programs.

Technical Sessions

The first educational program was "A Symposium on the Business of Plating." At this session, the needs and desires of the customer were examined and a report made on how closely these needs were being met. As a part of the same symposium, the assembled platers were told how to establish sensible specifications on plated products and how to set up manufacturing controls to see that established specifications are met.

The problem of control in plating was discussed by R. E. Harr of Western Electric Co., Chicago, in a paper "Quality Control in Electroplating." Mr. Harr told how control charts can be prepared and used in maintaining specification limits in plating.

Scheduled as the closing symposium of the first educational session was a discussion of the availability of materials necessary to the plating industry. However, because of the change in the material supply picture between the time the program was scheduled and the date of the annual meeting, this part of the program did not have too much to offer. Typical was one speaker who jokingly stated that rather than make a report as he had originally intended, he would use his allotted time to book any orders his listeners would care to give.

The second educational session was devoted to the problems of copper, nickel and chromium plating. In all, four papers were presented.

Because of the high interest in the subject and wide variances in opinion, the educational session on acid dips was in the form of a round table. To start the discussion, four papers were presented covering dips for ferrous, copper-base, and zinc-base metals.

The ascendancy of light metals and the plating processes developed for them resulted in one educational session being devoted to the plating of aluminum and magnesium.

Problems under investigation through the A.E.S. research program were reported on and discussed in the fifth and final educational session. The problems included: "Distribution of Electrodeposited Metal on Some Simply Shaped Cathodes", "Outstanding Problems of Porous Structure in Electrodeposits," and "The Present Status of Plating Room Waste Disposal."

The Founders' Gold Medal for outstanding contribution to plating progress was awarded to the trio of W. A. Wesley, W. W. Sellers and E. J. Roehl on the basis of the work they did and reported on in the paper "Electrodeposition of Nickel at High Current Densities." Among other things reported on in the paper, the authors showed that nickel could be deposited satisfactorily at high current densities, with a consequent increase in speed of deposition. In one case, they reported that sound nickel deposits were made at the rate of 0.001 in. in 16 sec. Such deposits were less ductile than deposits made at a normal rate, but did provide good protective qualities in porosity and atmosphere tests.

Convention delegates selected Chicago as the site of the 1952 convention. It is likely that an industrial finishing exposition will be held in conjunction with that convention. Boston had previously been chosen for the 1950 convention and Los Angeles for the 1951 meeting.

Electrically Conductive Glass Is Useful for Heating Applications

—A NEW MATERIALS PREVIEW

A new type glass that conducts electricity should find many applications in nonfogging and nonicing glazings and as shielding in the high frequency radiation field.

A deicing windshield made of electrically conductive type glass. Electrodes that feed electric current into the glass can be seen at the tops of the two glass sections. (Courtesy Libbey-Owens-Ford Glass Co.)

● ONE OF THE IMPORTANT wartime developments in the glass industry was the production of an electrically conductive type of glass. It is especially interesting to find that glass and rubber, two of the standard insulating materials, were each produced as semiconductors of electricity at about the same time in response to military demands. Both are now finding civilian uses.

An electrically conductive glass is offered as a standard article by the Libbey-Owens-Ford Glass Co. under the trade name Electrapane. The company holds a patent covering its method of manufacture. The Pittsburgh Plate Glass Co. also makes an electrically conductive glass called Nesa.

Applications for the conductive glass will probably lie in three types of uses: (1) nonfogging and nonicing glazings; (2) transparent shielding for high frequency radiation, and (3) novelty heating units.

While a considerable part of the production will probably find its way into military and commercial aircraft, the material has been or is being tested for glazing for automobiles, ships, locomotives and tractors. Deicing and defogging is accomplished here, as in aircraft, by passing a current through the conductive layer and so generating heat.

It has been found that the electrically conductive glass provides good shielding against stray radio frequency radiation. Where transparent enclosures must provide such shielding, as in radio control towers, glazing with the conductive material would seem to offer a solution.

Certain types of heating units in which some property of glass is combined with the heating function have been produced experimentally. One of these is a bathroom mirror that also serves as a radiator. Here the conductive property of the glass is used to provide a heat-generating element, while the glass surface is made reflective to light in the usual manner. There is a wide range of possibilities for devices such as this, both industrially and in the consumer field.

Properties and Characteristics

The electrically conductive glass produced by Libbey-Owens-Ford is made by coating glass with a very thin film of stannic oxide. The film is about 0.00002 in. thick, and is transparent because of its extreme thinness. It can be applied to one or both surfaces of the glass, and is quite durable in exposure to the

weather. The film is applied at a temperature approximately equivalent to the softening point of the glass. The process leaves the glass in a strained condition, so that there is sometimes a slight amount of optical distortion, as with the heat-strengthened glass panels.

When the glass is to be used for nonfogging glazing it is made as a safety laminate, with a plastic interlayer. The conductive film is then made one of the inside faces, in juxtaposition to the plastic. This permits the glass itself to serve as an insulator for the film, eliminating the danger of short circuit or shock. Adhesion between the film and the plastic is good, and the conductive safety glass retains the safety features of ordinary laminated glass.

For the laminated conductive glass, it is important that the temperature of the plastic laminating material be held below about 150 F if good optical properties are to be obtained. The conditions of film formation impose another limitation upon the conductive glass. As thin glass is difficult to hold at a temperature near its softening point without warping, the thinnest glass that can be properly coated is about 7/64 in. thick. Thicker sheets will be more satisfactory in most cases, as the strain-hardening effect will be greater, resulting in greater mechanical strength.

The electrical properties are probably of greatest interest. Resistance will vary somewhat, as the film cannot be made absolutely uniform, and the thicker films obtainable on thicker glass mean lower resistivity. A good average value would be about 100 ohms, but on thin sheets it may be as high as 135 ohms.

Resistivity is given as resistance per square area. This means that any square area will have a resistivity of about 100 ohms, whether 1 sq. in. or 1 sq. ft. Whenever the length of the path and the width of the sheet (film) are the same, the resistivity is 100 ohms. As the length of the path increases, the resistance increases by the number of times that the length contains the width, *i.e.,* the path becomes a number of square areas in series. As the width of the sheet increases, the resistance decreases as it would in a round conductor with increase of diameter, or the path may be considered to become a number of square areas in parallel.

As an example, a strip of conductive glass 1 ft. by 4 ft., with a resistivity of 100 ohms can be used. With contacts at the short ends, the path is 4 ft. long and 1 ft. wide. Total resistance is:

4 sq. areas x 100 ohms = 400 ohms

With the contacts at the long ends, the path is 1 ft. long and 4 ft. wide. Total resistance is:

¼ of a sq. area x 100 ohms = 25 ohms

This idea of a conductive path that is practically two-dimensional rather than three-dimensional sets several additional limitations to the use of conductive glass. One of these is in the matter of making connection into the circuit. A wire fastened directly into a point on the film would result in an excessively high current density at that point in the film, so a means of applying the current to the entire width of the film is needed. This is accomplished by using an electrode extending along most of the width of the film at both ends of the path. Electrodes of copper foil, fused silver flux, and sprayed metal have been used. The latter two are preferred for aircraft glazing. Electrodes must be carefully installed if difficulties at the electrode-film interface are to be avoided, especially at high voltages.

Another limitation is in the shape that the sheet of conductive glass may take. Sheets having curved ends, or of irregular shape, show hot spots over the surface of the film. While experiments with curved electrodes and shaped sheets of conductive glass are being carried out to produce uniform heating, these have not been completely successful so far. Hot spots seem to occur along the electrodes, and especially at the ends of the electrodes. For the present, it is best to confine the glass to rectangular shapes, and electrodes to those that are straight, equal in length, and equidistantly spaced. Slight inequalities in electrical resistance occur in the film itself, but these are so small that they cause no trouble in nonicing installations.

Where safety glass is not used, temperatures may rise to about 450 F before the resistivity of the film changes appreciably. At higher temperatures the resistance increases. Cold room tests using a 440-v. potential across the film have shown no film breakdown. Either alternating or direct current can be used.

Most of the present applications of electrically conductive glass are concerned with production of heat through electrical resistivity. The voltage required to produce a given wattage per sq. ft. is given by the formula

$$E^2 = 100(Wd/L)$$

where E is the voltage required
W is the wattage to be produced
d is the distance between electrodes, and
L is the length of the electrodes

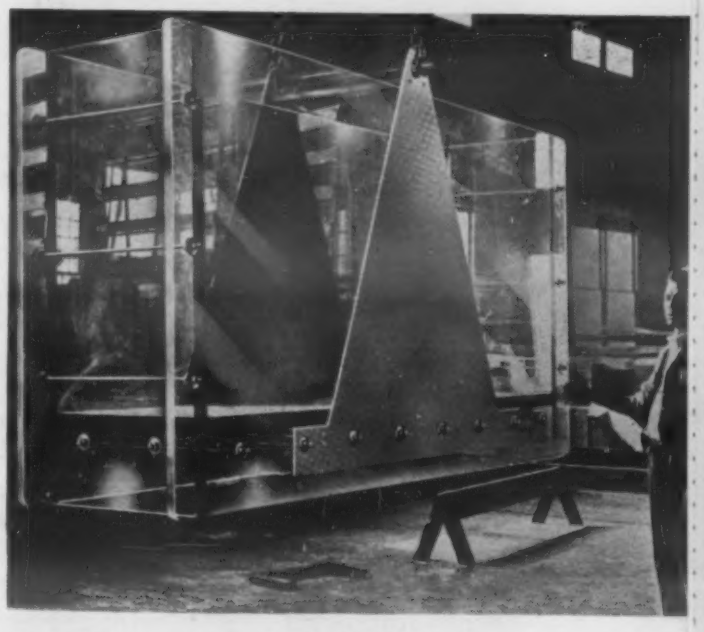
When the energy required is given in Btu., it can be converted to watts by the equation

1 Btu. per hr. = 0.29 watts

The energy in watts can be converted to Btu. per hr. by

1 watt = 3.4 Btu. per hr.

While the many variables, such as wind velocity, outboard temperatures, construction and location of the glazing, make it difficult to fix upon a figure for the amount of energy needed to de-ice aircraft glazing, 2000 to 4000 Btu. per sq. ft. per hr. have been mentioned. If a figure of 3000 Btu. be decided upon, 880 w. per sq. ft. must be provided. This can be done by applying sufficient voltage, or by making the distance between the electrodes small. Using several electrodes, equidistantly spaced and connected for maximum wattage output, instead of only one at each end of the path can accomplish this result.



One of the possible uses of electrically conductive glass is for tanks in which liquids must be maintained at temperatures somewhat above room temperature. (Courtesy Pittsburgh Plate Glass Co.)

Variation in the resistivity of the film with change in temperature is so small over the range between about 20 F and 160 F that it cannot be used for measuring or controlling temperatures. When a temperature control is to be applied to laminated conductive glass, it is best done by imbedding fine wires having a large temperature coefficient of resistance in the plastic interlayer. This can be connected to relay circuits for proper current limitation.

Lower Cost Aluminum Die Castings Possible Through Use of Scrap Metal

by JAMES H. HAMNETT

A large producer of die castings has made substantial savings without sacrifice in quality by the direct use of reclaimed aluminum scrap.

● REMELTING SCRAP aluminum for direct use as die casting metal is worth consideration in many cases, for it can result in attractive cost advantages. In addition, experience has shown that aluminum wrought and cast products produced entirely from scrap metal possess performance and fabricating characteristics that are equal to those whose base is so-called virgin ingot.

Perhaps a detailed description of one large aluminum die casting installation which uses all scrap aluminum (except for the alloying constituents) for die casting will serve to illustrate the results that can be attained. In this case the use of scrap aluminum coupled with the use of low-frequency induction melting furnaces has yielded a product of superior quality, has greatly facilitated general operations, and has resulted in significant reductions in overall costs.

Method and Equipment

The die casting products produced by this company include pistons, carburetors, cylinders, ornamental hardware, structural members, etc. The casting alloys being used for these castings are No. 13 and AXS-679-Rev.3. The composition of these two aluminum alloys as used is as follows:

	Alloy No. 13, %	Alloy AXS-679-Rev. 3, %
Silicon	10-12	8-9
Copper	0.60 max.	3-4
Iron	1 max.	1 max.
Manganese	1 max.	1 max.
Magnesium	0.10 max.	0.10 max.
Zinc	1 max.	1 max.

Purchased aluminum scrap in all of its various forms—briquettes, solids, borings and turnings, loose clippings, and foil—is accumulated in proper proportion as to grade in order to maintain current melting schedules. The bulk of Alloy No. 13 requirements are met with 2S and 3S scrap aluminum. For the copper bearing alloy, AXS-679-Rev.3, a number of alloys are used, including 25S, 195, 12, 17S and 18S, according to immediate availability. These latter compositions are blended when necessary with sufficient quantity of 2S and 3S to adjust to chemical specifications. Necessary silicon additions take the form of pure material (1% iron, maximum), and scrap copper wire is used as required. All scrap is stored according to strict classification in order to facilitate remelting operations and maintain a constantly balanced inventory.

Melting is carried out in a battery of 60-kw. Ajax-Tama-Wyatt twin coil induction units. These furnaces are capable of consuming 5 lb. of aluminum per kw.-hr., and thus deliver 300 lb. per hr. each of molten metal. In the case at hand, this capacity has been altered to permit consistent melt rates of 400 lb. per hr. without entailing additional expense, man-power, or alterations in equipment. Thus, with the eight units available, it is possible to melt, alloy, and deliver to the casting units some 3,200 lb. per hr.

Since stirring, fluxing, settling, etc., is unnecessary from a metallurgical standpoint, unusual economies in man-power requirements are realized. When operating at full capacity as outlined above, the following labor force has been found to be adequate: one furnace operator; two furnace assistants; two ladle men (for transferring metal to the 39 casting units); one charge assembler; two laborers for moving metal; one semi-skilled analyst; and one supervisor. Using average wage rates in existence today, actual experience over a significant period of time has shown direct labor cost figures to approximate about $0.005 per lb., varying somewhat, of course, on production requirements.

Spectrographic analysis of each heat provides a close check on material being consumed, and the availability of complete, interlocked furnace records makes possible immediate alterations in metal quality when necessary. While the composition of the metal in the remelting units tends to vary between comparatively wide limits, the cushioning effect of the substantial bath maintained in the 20-kw. holding furnaces produces an even final analysis.

Each of the 60-kw. induction units occupies a floor base area of only 4 by 4 ft. Furthermore, a self-contained tilting mechanism eliminates the necessity for pits or other costly arrangements. The lack of high ambient temperatures coupled with the absence of products of combustion does away with complicated and expensive ductwork and stacking. These units possess a high thermal efficiency which results in little heat loss through radiation and leads to attractive working conditions. It is quite safe to touch the outer shell of such a furnace containing molten metal at 1400 F, while the hand can be held within a few inches of the surface of

View of a large die casting plant equipped with induction furnaces for melting and holding aluminum metal prior to casting. (Courtesy Ajax Engineering Corp.)

the bath without danger of burning

Maintenance requirements are few but important. Like any other equipment, these furnaces require periodic inspection in order to insure normal, efficient operation. An installation the size of the one under consideration presented initial problems at the outset peculiar to itself because of lack of any precedent. It was found to be most effective to train certain personnel in all of the construction and operating details of these units rather than to depend upon various divisions of existing maintenance departments. In this manner, and through the medium of adequate control records, the entire operation became highly centralized, with resulting maximum efficiency. All electric maintenance work was assigned to two laborers on each 8-hr. shift. These same crews received the further responsibility of installing all new equipment and rebuilding worn-out equipment when necessary. Needless to say, since 47 furnaces were in-

Close-up of aluminum die casting equipment with a 20-kw. induction holding furnace. (Courtesy Ajax Engineering Corp.)

volved in this program, the burden placed upon per-pound-melted costs by this schedule was insignificant. Lining life of the holding units is now running 24 months, while the permanence of a 60-kw. installation can be expected to achieve almost indefinite duration. One such unit, recently rebuilt as a result of damage incurred through experimental work, was in constant service for more than two years, during which time an excess of 3,000,000 lb. of scrap aluminum was melted.

Experience with dross accumulations during these scrap melting operations have shown further remarkable results. Oxide losses checked over a three-year period have been found to average some 3% of the total melt. This figure represents "wet" skim removal, no flux of any sort having been used.

Cost Reductions Possible

As pointed out previously, the method described above of remelting scrap aluminum for direct use as die casting metal has attractive cost advantages. Overall melting costs in any particular case depend upon many different factors, including current production requirements and the general efficiency with which furnace capacities can be utilized.

Local power rates will naturally determine fuel costs for melting. In general, with melting rates of 5 lb. of aluminum per kw.-hr. input, the cost of power in many areas is such as to show possibilities for savings. Coupled with considerations of power cost must be the savings that can be realized through reducing labor costs, labor turnover, maintenance and installation expenses, and general operating overhead. The savings in these items in many cases result in a favorable position for induction melting even where high energy rates are encountered.

The installation described here provided excellent opportunity to fully realize the advantages of induction melting. The overall charge per pound of metal remelted, alloyed, and delivered to the die casting machines was about $0.012. This figure is based on an average melting capacity of some 50,000 lb. per day and an electric power rate of $0.006 per kw.-hr. Other items considered in arriving at this cost figure include: direct and indirect labor (excluding some unloading operations), maintenance, necessary laboratory personnel, supervision, demurrage, and all tools and supplies. Not included is any charge for melt loss.

To arrive at the total savings realized in this program, the cost of the scrap material and alloying elements was added to the cost of processing and remelting.

Thus, with the above savings in die cast metal, this program has actually led to a yearly money savings of as much as $250,000 over standard costs. From this actual case history, therefore, it should be evident that die casting producers might well consider the adoption of such a program to reduce metal purchasing costs and requirements. Reclaimed aluminum scrap, if properly handled and segregated throughout the plant, can be immediately remelted and used directly in the production of castings. Where volume of production warrants, acquisition of scrap materials from outside sources will often result in additional savings, and shortages arising out of allocation can be avoided.

Reclaimed aluminum scrap, if properly processed and blended to adjust to chemical specifications, can be used to produce satisfactory die castings. (Courtesy Curtiss-Wright Corp.)

All scrap must be sorted and stored according to strict classification to facilitate remelting operations. (Courtesy Curtiss-Wright Corp.)

View of test set-up showing how the thermocouple was placed in the seam.

Soldering Does Not Affect Properties of Cold Rolled Copper

by EDWIN LAIRD CADY

Does heat of soldering by itself lower the hardness and strength properties of cold rolled sheet copper? The tests described here indicate that there is no such effect.

● A WIDESPREAD BELIEF holds that soldering heat alone can cause annealing of cold rolled copper. It is important to determine the validity of this belief, since in many applications where soldering is involved sheet copper in the cold rolled or "hard" condition rather than in the annealed condition is required to provide satisfactory properties such as hardness, yield strength, or tensile strength. The following table, which is complete enough for purposes of general comparison, shows the difference in these properties in the cold rolled and annealed conditions.

The hard condition, then, is superior in columnar strength, in resistance to wrinkling when exposed to temperature variations, in strength for use in pressure vessels, in rigidity, in spring quality, and in other factors with which the materials engineer is familiar.

	Cold Rolled Condition	Annealed Condition
Hardness	Rockwell B50	Rockwell F40
Tensile Strength, psi.	50,000 or more	32,000 or less
Yield Strength, psi.	42,000 to 48,000	10,000

Temperatures Attained While Soldering Copper Sheet

Length of Seam Completed, In.	¾-In. Single Lock Seams (5 Tests)					1½-In. Lap Seam (One Test)
	1	2	3	4	5	
1	80 F	85 F	80 F	85 F	85 F	75 F
2	90 F	90 F	80 F	90 F	85 F	90 F
3	115 F	100 F	95 F	100 F	95 F	120 F
4	185 F	135 F	150 F	140 F	125 F	230 F
5	280 F	190 F	320 F	185 F	255 F	410 F
6*	525 F	360 F	570 F	495 F	475 F	480 F
7	470 F	375 F	470 F	375 F	415 F	350 F
8	415 F	325 F	400 F	345 F	400 F	325 F
9	375 F	305 F	360 F	305 F	370 F	295 F
10	360 F	300 F	325 F	280 F	335 F	280 F
11	350 F	290 F	305 F	260 F	325 F	255 F
12	330 F	275 F	295 F	235 F	285 F	240 F

* Thermocouple located in middle of seam at this point.

In order to find out whether or not the heat from soldering actually anneals cold rolled sheet copper, engineers of Revere Copper & Brass, Inc., made some practical tests.

Heat of Soldering

To study the time at temperature during soldering, several ¾-in. single lock seams, 12 in. long, using 16-oz. copper, were soldered. Similarly, one 1½-in. lap seam was soldered.

In each seam, before soldering, one fine wire thermocouple was placed at the mid point of the seam, as shown in the accompanying figure. The thermocouple was directly beneath the layer of copper which would be in direct contact with the hot iron during soldering.

The highest temperature recorded at any thermocouple was 570 F, and this temperature endured for less than 10 sec. Satisfactory soldering was done when the highest temperature was only 470 F. The general range of highest temperatures was 475 to 525 F, the 570 F being attained only by the use of an extremely hot iron.

Readings were taken at every inch of progress of the iron along the seam. The readings show that the copper heats up cumulatively ahead of the iron, that the highest temperature is generally that directly beneath the iron, and that cooling down after the iron has passed is rapid enough so that the time at highest temperature is very slight.

Soldering a seam between two cold rolled copper sheets.

Heat of Pre-Tinning

It is common experience that 50-50 lead-tin solder drosses rapidly when its temperature is higher than 700 F. This, then, is a practical limitation on the temperature at which a bath of that material can be held when it is to be used for pre-tinning purposes.

Several pieces of copper, hardness range Rockwell 15-T 71 to 72, 16 oz., 6 in. long by 5 in. wide, cold rolled 5% from the soft condition, were prepared. One edge of each piece was dipped into molten salt. The temperature of the bath was held to predetermined figures within ±15 F, and the duration of exposure to the heat was carefully regulated. The depth of immersion was 2 in. Hardness readings were taken of these edges, at distances of ½ in., 1 in., 1½ in., 2 in., and 2½ in., back from the edge of each piece.

Up to a temperature of 550 F, no softening was noted. At 700 F an exposure of 1 min. produced no softening, and 2 min. produced only very slight softening close to the edge, with none at all 1½ in. from the edge.

At 750 F, only a trace of softening was noted at the very edge of the piece when the time of exposure was held at 30 sec. This is a much longer exposure than is needed for good tinning. And because of drossing, 750 F is too high a bath temperature for satisfactory results.

From the results of this test the following conclusions can be drawn. The soldering iron produced no temperatures recorded as being higher than 570 F, and since this is much lower than any temperature at which softening was found, no softening from the effects of the iron alone should be anticipated.

Even at temperatures higher than those at which drossing becomes a serious problem, and with exposures many times longer than are necessary for good tinning, no softening of the copper was found. On the evidence of these tests, a pre-tinning bath would have to be seriously mishandled before the pre-tinning operation would soften the copper.

While these tests were planned to find out the effects of soldering with the use of a soldering iron on relatively large sheets, the tests also suggest that when soldering on a production line basis, by iron or by blow torch or by furnace methods, a reasonably wide latitude of time and temperature limits can be allowed without softening the cold rolled copper.

Materials Engineering File Facts

NUMBER 178
August, 1949

Welding Processes—Uses and Equipment

Type of Process		Characteristics of the Process	Types of Equipment Available and Their Capacities
Gas Welding	Oxyhydrogen	For welding low melting point materials such as aluminum, lead, and magnesium; especially for welding aluminum sheets 1/32 to 3/16 in. thick. Surfaces to be joined must be clean; after welding, flux, spatter and excess weld metal must be removed.	Equipment is portable if compressed gases are used. Both manual and automatic equipment available. Manual and portable equipment can be used on work-pieces of all sizes. Automatic welders are generally special-purpose machines, designed for a particular job.
	Oxyacetylene	For welding steel and many nonferrous alloys; welding aluminum sheets over 3/16 in. thick; also used for deposition or hard-facing alloys (especially when applied to thin sections). The flame can be varied from carburizing to neutral or oxidizing, depending on requirements of material being welded. Surfaces to be joined must be clean; flux and excess weld metal must be removed after welding.	Same as above.
	Pressure welding	A relatively new process for joining steel pipe, tubing, rails and sheet. Surfaces to be joined must be machined for smooth contact; some upset metal must be removed after welding.	Equipment includes a multiple-flame oxyacetylene burner and burner control mechanism, pressure application and control mechanism, and work-piece clamping devices; equipment is for high production use and is not portable.
Resistance Welding	Upset butt	Limited to use in small wire working plants. Ends to be joined must be smooth; large area of upset metal may require removal.	Not generally portable; both manual and automatic machines are used.
	Flash butt	For joining sheets to form strip and to weld circled strips and bars to form rings, and for joining sections of pipe or tubing. Dissimilar alloys can be welded. For high production operations where speed and low cost of operations are important. No special pre-welding treatment required. Flash, extrusion and spatter must be removed after welding.	Equipment not generally portable; both manual and automatic high production machines are used. Sections from 0.015 to 4 in. can be joined by this method.
	Spot	Has a wide range of application in both the job shop and in the high production industries for joining sheet stock. Most metals and alloys (including some clad steels) can be spot welded; this is one of the most commonly used processes for joining magnesium alloys. Usually the two sheets to be joined should be near the same thickness; a maximum ratio of thicknesses of the sheets to be welded is about 4 to 1. Materials to be spot welded must be very carefully cleaned prior to welding; no post-welding cleaning or grinding is required except in the case of magnesium alloys which must be cleaned (to remove any copper picked up from the electrodes) and given a surface-protection treatment.	Both portable and stationary, hand and automatically operated machines available. Standard a.c. and "stored energy" types of spot welders used; former have lower first costs and latter types make a smaller kv-a demand on the line. Portable battery operated units available; also portable units requiring air power and water connections are made for 1 or 2 guns (pinch and/or push type). Some portable units have self-contained electrode cooling systems, eliminating the need for water connections. The guns can be manually, hydraulically or pneumatically operated. For repetitive operations, guns can be over-head supported, giving access to large work-pieces. Throat depth and total electrode stroke (retraction plus working stroke) limit the capacity of any particular gun or single-unit spot welder; a wide variety of capacities available. Automatic and semi-automatic press-type machines have been designed for special high production jobs. Portable spot welders have capacities from 0.01 to 1/8 in. in thickness; stationary machines weld 0.001 to 1 in. thick materials.
	Seam	A fast, high production method for joining sheet stock; straight and circular pressure-tight welds can be made at speeds of over 100 in. per min. Some clad steels, carbon, low and high alloy steels, many copper, magnesium, aluminum and nickel alloys can be joined. Prior to welding the material must be very carefully cleaned; no post welding cleaning is required except in the case of magnesium alloys, which must be cleaned and given a surface-protection treatment.	Most are not portable; their control is large, expensive and delicate. Some seam welding guns (portable, air operated machines) available. Seam welders built for welding longitudinal, circular or transverse seams. Also, universal, or multipurpose, types (adaptable to either longitudinal or circular seam welding) are in use. On many machines the lower welding wheel is driven, the upper is an idler; special purpose machines may have positive drive to both upper and lower wheels. Type (*i.e.*, whether longitudinal, transverse or circular), sizes of welding wheels, throat depth and electrode stroke all combine to govern the capacity of a seam welder. Material thicknesses of about 0.001 to 0.375 in. are weldable.

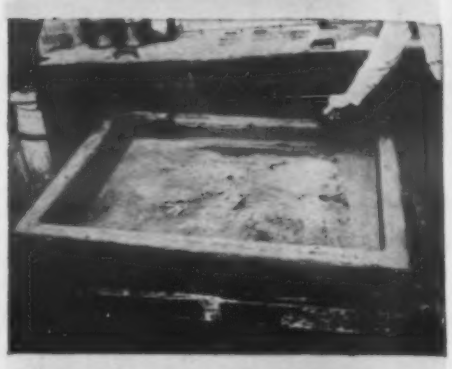
(Continued on page 79)

MAINTENANCE CUT

Several Thousand Dollars Per Year with **KAOCAST**

Photographs courtesy Ford Motor Company

KAOCAST, easy to use as ordinary concrete, can be mixed in mortar box or concrete mixer.



Shell of furnace door, cleaned, ready for installation of KAOCAST.

Shoveling KAOCAST into place. KAOCAST can also be poured like ordinary concrete, plastered in place, or applied with a cement gun.

A large automobile manufacturing firm found that high temperatures and severe operating conditions were playing havoc with the doors of their 15-ton electric furnaces. Run 16 hours a day, 5 days a week, these furnaces are poured every 2½ hours and are charged twice during each cycle. With a good grade of firebrick, furnace door linings lasted an average of only two or three days before replacements were necessary.

A trial installation of KAOCAST—the B&W high temperature Refractory Castable—was made. The KAOCAST doors stood up two to three weeks . . . *five to eight times longer than firebrick.* As a result, doors on all electric furnaces of this type are now lined with KAOCAST. *Savings in maintenance are running into thousands of dollars per year.*

Your B&W Refractories Engineer will be glad to show how KAOCAST will cut your furnace operating cost. Write or call him today.

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Materials Engineering File Facts

NUMBER 178 (continued)

WELDING PROCESSES—USES AND EQUIPMENT

Type of Process		Characteristics of the Process	Types of Equipment Available and Their Capacities
Arc Welding	D.c. carbon arc	Carbon steels, copper and copper alloys, stainless steels and aluminum can be welded (especially when machine welding is advantageous). Work is made the positive pole of the arc, the carbon electrode the negative side; this type of welding is usually done in down-hand and flat positions. Prior to welding the surfaces to be joined must be cleaned; generally it is unnecessary to perform any post-welding cleaning or grinding.	A variable-voltage d.c. generator is commonly used; automatic welding machines are not portable. Machine carbon arc welding is more efficient than hand welding. Flux can be applied from a fluxed tape or in a powder or paste form. Electric motors, gasoline or diesel engines can be used to drive the generator.
	D.c. metal arc	The most commonly used welding process is the d.c. shielded metal arc; most metals and alloys can be welded by this process if the welding rod, current and polarity are all properly chosen. Nonferrous electrodes that do not give good results with an a.c. arc can be used. Automatic equipment is used to make steel tubing from light gage sheets. D.c. arcs are not generally used for welding in restricted areas. Surfaces to be welded must be reasonably clean and the weld generally is ground to clean it up.	Manual equipment is portable. Both single and multiple operator units and automatic welding machines widely used. Automatic metal arc machines are more efficient than manual welding types; for automatic welding, work must be positioned and either the work-piece or the welding head can be traversed, depending on type of machine. Motor-generator sets are very efficient; a 200-amp. machine will handle a wide range of utility jobs; a 300-amp. welder will take care of most large jobs.
	Hidden arc welding	Uses a bare (metal) rod and granulated flux (the arc end of the rod is covered by the flux during welding). A very efficient way of welding; generally employed as an automatic or semi-automatic operation, using a welding machine. Stainless and clad steels, copper-silicon, and nickel alloys as well as heat resistant alloys can be welded by this method. Surfaces to be joined must be reasonably clean before welding; some cleaning and snagging after welding may be desirable.	Equipment is usually automatic or semi-automatic (generally not portable); either the welding head or the work-piece can be traversed, depending on the type of machine. Control of arc and electrode position plus mechanism for proper deposition of flux are required.
	A.c. metal arc	Welds in restricted areas or in overhead or vertical positions can be made; higher currents can be used than is possible with d.c. arcs permitting thicker materials to be welded. Process not suitable for welding with aluminum, copper alloy, nickel alloy, or bare steel rods. A.c. welding equipment has lower no-load losses than d.c. machines. Surfaces to be joined must be reasonably clean and after welding the usual snagging or grinding may be necessary.	Portable or stationary, single or multiple operator units. Transformers are more efficient than motor-generator sets.
	Inert-gas shielded arc	For welding materials that are difficult or impossible to weld by other processes; stainless steels, aluminum, magnesium, Hastelloys, nickel alloys, copper alloys, hard facing alloys, and silver can be readily welded. An inert gas for shielding the arc (either helium or argon) is used with either an a.c. or a d.c. arc. No filler rods needed with materials less than 1/16 in. thick and no flux is used; welds can usually be made in any position. Before being joined the surfaces should be reasonably clean; snagging and polishing may be required after welding; aluminum and magnesium alloys must be carefully cleaned and given an appropriate surface-protection treatment after welding.	Water cooled tungsten electrodes are used; if compressed helium or argon is available, the equipment can be portable; argon is cheaper than helium on a job basis. A d.c. inert gas arc is more efficient than an a.c. arc; the efficiency of an a.c. arc can be increased by using a high frequency generator (this gives a more stable arc). Both manual and automatic equipment available. A 500-amp. hand welder will weld materials up to 2½ in., or more in thickness (depending on the weldability of the material); minimum thickness for hand welding is about 1/32 in.; machine welds have been made on materials as thin as 0.005 in.
	Atomic hydrogen arc	For specialized applications where other processes are not suitable. Automatic equipment used for welding stainless steel tubing; high speed, high nickel and high chromium alloys and light gage sheets are welded with an atomic hydrogen arc. Surfaces to be joined must be clean, and weld spatter may need removal after welding.	Manual equipment is portable; automatic equipment for machine welding is available and is not portable. Tungsten electrodes are used; customary types of a.c. power supplies are employed (the arc is a.c.).

Compiled from data in the "Metal Industries Catalog"

WHY NYLON PLASTIC FOR SAFETY GOGGLES?

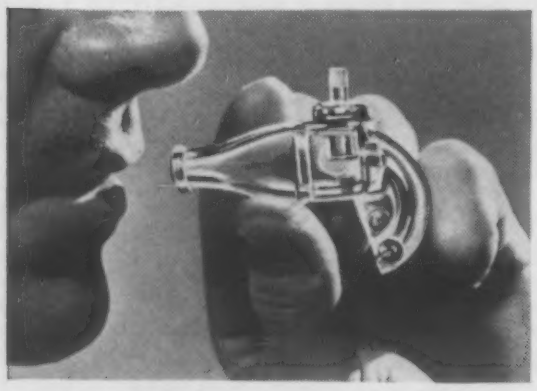
A flying spark or metal chip . . . a machine run amuck . . . a squirt of acid. Such mishaps can cause serious eye injuries to welders and other plant workers.

To give workers' eyes the greatest possible protection . . . protection far beyond ordinary requirements . . . one manufacturer set out to produce a super-strong, light-weight safety goggle. In addition to extra-durable lenses, he needed eye cups to withstand the hardest blow and resist heat and perspiration. They had to be light in weight and comfortable to wear. After studying various materials, the manufacturer found *the* material for the job in tough molded Du Pont nylon.

Nylon, he found, has great compressive strength . . . high impact resistance. Even after being squeezed in a vise, the nylon cups snap back to normal shape. These goggles are molded to fit facial contours with comfort, fitted with tough lenses. According to the manufacturer, these goggles will last a lifetime . . . give the worker better eye safety than any previous goggle.

The advantages of nylon, as well as those of other plastics in the Du Pont family, may help you improve your own products or design new ones. It's easy to get all the facts. Write E. I. du Pont de Nemours & Co. (Inc.), Plastics Department, 350 Fifth Ave., New York 1, N. Y.; 7 S. Dearborn St., Chicago 3, Ill.; 845 E. 60th St., Los Angeles 1, Calif.

Safety goggles made by Willson Products, Inc., Reading, Pa.



WHAT'S NEW . . . For penicillin powder inhalation, this "Aerohalor"* is made of Du Pont "Lucite"* acrylic resin by Abbott Laboratories, North Chicago, Ill. Abbott uses "Lucite," because it doesn't cause deterioration of penicillin, looks attractive, is easy to clean and resists breaking. "Lucite" also is odorless, tasteless, non-toxic and pleasant to the touch. *REG. U. S. PAT. OFF.

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MATERIALS & METHODS

DIGEST

A selective condensation of articles—presenting new developments and ideas in materials and their processing—from foreign journals and domestic publications of specialized circulation.

Edited by H. R. CLAUSER

Fiberglas Used for Helicopter Blades

Helicopter blades made of molded Fiberglas have proved superior to some conventional types, both aerodynamically and structurally, according to an article in *Technical Data Digest*, July 1, 1949. The blades were developed for the Air Materiel Command by the Cornell Aeronautical Laboratory.

Averaging 20 in. in width, the Fiberglas blades are about 22 ft. long. They are molded integrally in a single operation and use a light-weight, high-strength sandwich-type of construction. The sandwich is made from a large thickness of very light core material like balsa wood. This core material is placed between thin face layers of a comparatively heavy, high-strength material like sheet metal. The core and face layers are then fastened together by an adhesive, leaving them an integral structural unit.

In the new rotor blades, the face material is a laminate composed of multiple layers of Fiberglas cloth imbedded in a plastic material. The cloth, which provides the structural strength, is bound together by the plastic so that individual layers will act as a single unit capable of carrying both tensile and compressive loads.

Engineers are currently considering extending the development to make all Fiberglas blades in which the balsa wood core will be replaced by a honeycomb core made of resin-impregnated Fiberglas cloth molded into a light cellular structure. These proposed blades are expected to be lighter and more easily fabricated than the present type, which they equal in lifting efficiency.

The efficient performance of these Fiberglas blades is attributed to two factors. First, the molding process produces a blade with an extremely smooth surface. Second, the sandwich-type construction gives the blade a rigid cross-section, which is not deformed by structural loads or aerodynamic forces applied to it in flight.

● An expansion of the possibility of using germanium crystals in radio and television applications heretofore served almost exclusively by vacuum tubes was reported to a conference on electron tubes and solid state devices at Princeton University by Rowland W. Haegele, Sylvania Electric Products, Inc. The meeting was sponsored by the *Institute of Radio Engineers*. Haegele described the construction and experimental performance of germanium crystal tetrodes in mixer applications, where he stated that the crystal tetrode offers certain advantages over germanium crystal diodes and triodes.

Developments in Automatic Hard Facing

Automatic electric welding, in extensive use for a good many years, has greatly widened the scope of welding. Until recently this process was applied primarily to the joining of steel parts in fabrication, using the conventional mild-steel and low-alloy welding wires in continuous coil form. Now, however, with the development of continuous high-alloy wires, the field of automatic welding has been enlarged to include hard facing.

H. W. Sharp, in a paper presented at the *American Welding Society* sessions of the Western Metal Congress in April, discussed the developments in this field. He pointed out that the automatic method has these distinct advantages: completely uniform deposits are continuously welded at a much higher welding speed, welding efficiency is higher since no hard facing alloy is lost in stud ends, and deposits are greatly superior to the best manual welding.

Experience has shown that the automatic application is readily adapted to practically any equipment or parts on which hard facing can be laid in a series of continuous stringer beads. This may be on a cylindrical piece where beads are placed circumferentially or on flat work where the deposit can be made as a series of straight stringer beads.

Automatic hard facing wires are produced on special machines which form a continuous tube from mild-steel strip; the granular or powdered-alloying ingredients are added as the strip is being formed. This fabrication method permits the production of material of higher alloy content than is possible to obtain in a conventionally drawn wire, yet retaining sufficient flexibility for coiling and unreeling during automatic welding. Wire in tubular form permits an almost unlimited variety of alloys. Iron-base materials can be produced with alloy content as high as 60%.

Most of the hard facing alloys now available as manual electrodes can be made for automatic application. One group of hard facing wires is made with alloy content varying between 5 and 10%. These materials have hardness values ranging from 35 to 55 Rockwell C hardness. Deposits of these materials possess good abrasion resistance in combination with impact strength and are low in cost.

Another group of hard facing wires includes those containing alloys from 10 to 35%. This group of materials can be made with a high carbon content to provide excellent resistance to abrasion, or they can be made with alloys which impart heat and corrosion resistance. Tungsten carbide tube-type material is also available for automatic electric application to parts subject to severe earth abrasion.

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DIGEST

Properties of Aluminum Alloys at Elevated Temperatures

Over the past few years, there has been increased interest in using aluminum alloys at elevated temperatures. A report of the creep behavior of a number of alloys of current interest was recently made by J. E. Dorn and T. E. Tietz at the annual meeting of the *American Society for Testing Materials,* June 1949. The alloys selected for their investigation were classified into two major groups as follows: Class I, alloys which are not hardenable by precipitation, including 3S-H12, 3S-H18, 52S-H32, and 52S-H38; and Class II, alloys which are precipitation hardenable, including 61S-T6 (bare) and 24S-T3 (bare).

The creep and stress-rupture characteristics of these alloys were studied from 90 to 400 F for times up to 1000 hr. It was found that alloy 24S-T3 exhibited the best resistance to creep and stress rupture, and 61S-T6 was second best among the alloys tested. The order of resistance to creep and stress-rupture among the cold-rolled metals was 52S-H38, 52S-H32, 3S-H18, and 3S-H12. Little difference, however, was noted between 52S-H32 and 52S-H38 at 300 and 400 F. Cold rolling appears to improve the creep and stress-rupture resistance of the work hardenable alloys.

Importance of Precise Surface Finishing

Development of ways to define and clearly designate surface finish requirements of instruments is essential, according to the paper by J. A. Broadston, presented at the semi-annual meeting of the *American Society of Mechanical Engineers,* June 1949.

He pointed out that precise surface finishing instructions once could be completely ignored, but the trend from skilled craftsmen and simplicity of design to machine operators and complexity has made proper designation and control of surface quality a vital design consideration.

Surface finishes are controlled in many shops only through a series of trials and errors, he said, and many product failures that occur in final performance tests are found to be the result of improper surface finish. However, the machine operator is not to be blamed for failures. The responsibility for surface finish control has shifted from the shop to the engineering department. The task of determining such exact surface finishes and of clearly designating them to machine operators now belongs there.

DIGEST

Effect of Temperature on Properties of Titanium

Relatively little is known about the effect of temperature on the mechanical properties of titanium. To obtain some information on this, an investigation was carried out by R. L. Bickerdike and D. A. Sutcliffe, and their findings are reported in *Metallurgia* (English), Apr., 1949.

The chemical analysis of the titanium used is listed below:

Titanium	—	99.68%
Oxygen	—	0.19%
Silicon	—	0.07%
Carbon	—	0.05%
Iron	—	0.05%
Aluminum	—	0.02%
Manganese	—	0.002%
Cobalt	—	0.001%
Nickel	—	trace

The tensile and hardness properties of this analysis were determined at room temperature and then at 572 and 932 F. Below are given the results of the tensile tests:

	Room Temp.	*572F*	*932F*
Maximum Stress (tons per sq. in)	41.1	17.3	12.2
% Elongation	33.2	25.3	16.6

It appears from the room temperature results that small quantities of impurities found in the present case more than doubled the room temperature hardness and increased considerably the tensile strength. In spite of the impurity content it was found that the metal could be cold worked.

Evaluation of Surface Preparation Methods for Metallizing

While metallizing is a convenient and economical method for repairing and rebuilding the surface of worn parts, the surface preparation prior to metallizing can result in a reduction of the fatigue resistance of the part. In a paper presented at the annual meeting of the *American Society for Testing Materials*, June 1949, W. L. Williams reports on the work done on this problem, and gives some useful information on selecting the proper method of surface preparation.

The four conventional methods of surface roughening, namely, electric bonding, grit blasting, rough threading, and groov-

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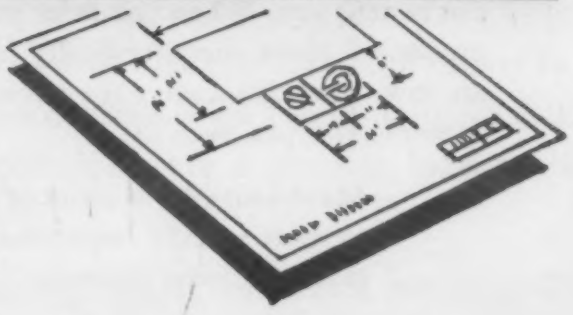
TOP PERFORMANCE

WITH AJAX TAMA-WYATT

INDUCTION FURNACES for Aluminum Alloys

Ajax Induction Holding Furnace at Mid-Western Die Casting Co., Chicago, Illinois.



BETTER PRODUCTION THROUGH TOP PERFORMANCE IS THE AJAX RECORD

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No flux or mechanical stirring is necessary. The metal is in constant gentle circulation assuring complete blending of alloys, and a uniform temperature throughout the metal.

Electric energy costs less than fuel and avoids danger of overheating. Completely automatic temperature controls hold metal to within 5°F., at the lowest possible temperature for perfect casting. With an Ajax the yield for perfect castings is exceptionally high.

There are no fumes and operation is practically noiseless. Shops are cooler, more comfortable — manpower efficiency is increased. Shop space is increased, for an Ajax Holding Furnace takes an average of 30 to 40 percent less floor space than any other furnace.

The Ajax companies have been pioneers in induction melting of metals since the first World War. To date they have installed more than 400,000 KW. of furnace capacity in the United States alone. This is the background of experience behind every Ajax installation.

AJAX ENGINEERING CORPORATION · Trenton 7, New Jersey

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Associate Companies: **AJAX METAL COMPANY,** Non-Ferrous Ingot Metals and Alloys for Foundry Use
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AJAX ELECTRIC CO., INC., The Ajax-Hultgren Electric Salt Bath Furnace
AJAX ELECTRIC FURNACE CORP., Ajax-Wyatt Induction Furnaces for Melting

DIGEST

ing and knurling, were investigated. Selection of the method for preparing surfaces for metallizing depends to a considerable extent on the nature, size and shape of the part. Nevertheless, in many cases, particularly for cylindrical parts, any one of a number of procedures can be chosen. In such cases, the grit-blast method of surface preparation is to be greatly preferred, provided the bond strength is adequate. In the case of quite soft materials, at least, the endurance properties will not be affected other than by loss in strength due to undercutting. Grit blasting prior to metal spraying is recommended for parts subjected to both bending and torsional stresses.

The experimental results indicate that electric bonding introduces more serious notch effects than either rough threading or grooving and knurling. However, the latter two processes require a greater amount of undercutting to be performed on a part being reconditioned. Consequently, in small parts, where the effects of undercutting are felt the most, the added loss in strength due to the extra undercutting can overshadow the notch effects. The electric-bond method would be better for parts under about 1-in. dia., and either the rough threading or grooving and knurling process for shafts of larger sizes. This size effect occurs with both bending and torsional stresses. Electric bonding, of course, must be used on steel of any size if the steel is too hard to machine.

These tests have been conducted on relatively soft machinery steels which are not expected to be very notch sensitive. Harder materials undoubtedly would be damaged to a greater extent from the notches introduced by the surface preparations.

Properties of Gray Cast Iron Containing Boron

Although it has been generally known that boron increases hardness and wear resistance of cast iron, specific information on the effect of boron on cast iron properties has been somewhat limited. In the *Journal of Research,* May 1949, A. I. Krynitsky and Harry Stern reported the results of a study on the effect of boron in plain gray cast irons.

The carbon content of the irons investigated varied from 3.3 to 4.1%, and the silicon content from 1.4 to 2.7%. The irons were melted in high-frequency induction furnaces, and boron in the form of ferro-boron was added to the molten metal

DIGEST

in amounts ranging from less than 0.001 up to 0.48%.

Information was obtained on solidification characteristics, strength, hardness, microstructure, and chilling properties. In general, the results of the investigation showed that boron increased the depth of chill of cast iron as well as its hardness. Boron was also found to decrease the size and quantity of graphite particles, to increase the free carbide content, and to produce an undercoating effect which becomes more pronounced with greater percentages of boron.

● A method for the colorimetric determination of aluminum in steel has been devised by L. G. Bassett and S. E. Wiberley at Rensselaer Polytechnic Institute, and is described in a recent issue of *Analytical Chemistry*. For a simple, rapid and accurate determination of small quantities of aluminum in steels, the sample is dissolved in nitric and perchloric acids. It is then fumed, cooled, diluted and electrolyzed in a water-jacketed mercury cathode cell until free of iron. The aluminum salt of 8-hydroxyquinoline (8-quinolinol) is formed in a buffered acetic acid solution. The salt is extracted with chloroform and the color intensity of the resulting solution is measured with a suitable colorimeter or spectrophotometer.

A New Bright Nickel Plating Solution

A new cobalt-free solution for bright nickel plating is reported in *Sheet Metal Industries* (British), June 1949. According to the article, the solution is cheaper to maintain and can be used without any change in equipment. The deposit obtained with this new solution, called Gleamax, is bright and ductile and no trouble has been experienced with pitting.

The bath is easy to maintain and control on production work, and has been successfully used on brass, steel and zinc die cast parts. The one precaution that must be taken is to electrolyze the solution periodically at a low current density with dummy cathodes to keep it free from metallic contamination.

The solution is maintained at a temperature of 120 to 130 F, has a pH value of 3.6 to 3.8, and is operated at a current

PROBLEM: To supply bearings for high speed pump handling steam condensate at over 300°F, 300 PSI . . . to function without conventional lubrication . . . requiring no maintenance.

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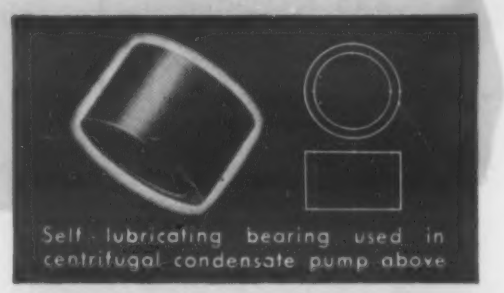
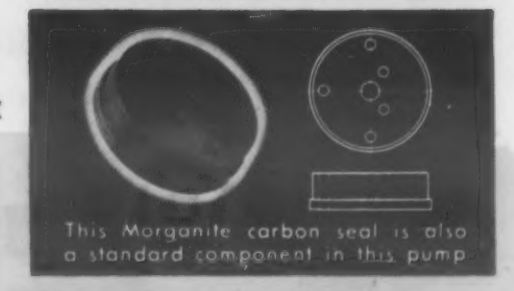
See our CATALOG in SWEET'S FILE

FOR DETAILS consult the Morganite Catalog in Sweets File for Product Designers; for engineering counsel or specific proposals, call in a Morganite sales engineer - no obligation.



Self-lubricating bearing used in centrifugal condensate pump above



This Morganite carbon seal is also a standard component in this pump

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DIGEST

density of 30 to 35 amp. per sq. ft. No organic wetting agent is present, which reduces trouble with foaming. The throwing power of the solution is equal to that of cobalt nickel at the same current density, and the brightness appears to be better than the cobalt type on poorly polished surfaces. This latter feature is a decided advantage where the work consists of cheap steel pressings that do not warrant expensive preparation.

Producing Large Magnesium Castings

Magnesium castings of 2 and 3 lb. were produced in Germany during the war on a novel, fully-automatic machine, described in a report, "Mahle Die Casting Machine and Dies," now available from the *Office of Technical Services, U. S. Department of Commerce.* The die casting machine is of a novel hot chamber injection design.

It is felt that if a fully automatic die casting machine with a device to protect the operator from molten magnesium could be designed using principles of the Mahle machine, a more uniformly high quality output might be achieved than is now possible. Particularly worthwhile would be the use of high hydraulic pressure for all operating and locking pressures of the press, as well as for operating and locking the cores, and for ejection of the castings.

The report suggests that the construction of dies utilizing fabricated base plates and cylindrical "screw-in" lugs is an economical measure which may find application in the construction of dies for plastic molding.

Cast Steels for Low Temperature Service

Cast steels are finding wide use as components of industrial and military units that are subjected to high stress concentrations and low operating temperatures. Therefore, good toughness at low temperatures is required under these conditions. J. F. Wallace, in his paper "Effect of Aluminum and Vanadium on Toughness of High Hardenability Cast Steels," presented at the annual meeting of the *American Foundrymen's Society,* May 2-5, 1949, points out that such engineering applications require a fine-grained, fully-hardened and tempered steel. The problem investigated and reported on in this paper is: what combina-

DIGEST

tion of alloys and what grain refiner will produce optimum toughness?

Of the three high hardenability steels employed in this investigation, a medium manganese-nickel-molybdenum steel appeared to produce the best toughness, followed closely by a low manganese-chromium-nickel-molybdenum steel with a high manganese - chromium - molybdenum steel definitely undesirable for components requiring high toughness. A survey of the literature indicated that aluminum, titanium, vanadium and zirconium could be used as effective grain refiners.

The results of this work show for the steels investigated that the aluminum-refined steels are more suitable for purposes requiring toughness than vanadium-refined steels. The literature contained some information that titanium was deleterious to high impact resistance. Little conclusive information was available on zirconium, however, and an investigation of the effect of this element should be considered for future work on this subject.

There are many other factors which influence the use of either aluminum or vanadium. These include the greater availability, lower cost, and lower strain aging rates of aluminum steels compared to the strengthening effect, better welding properties and superior high temperature behavior of the vanadium steels.

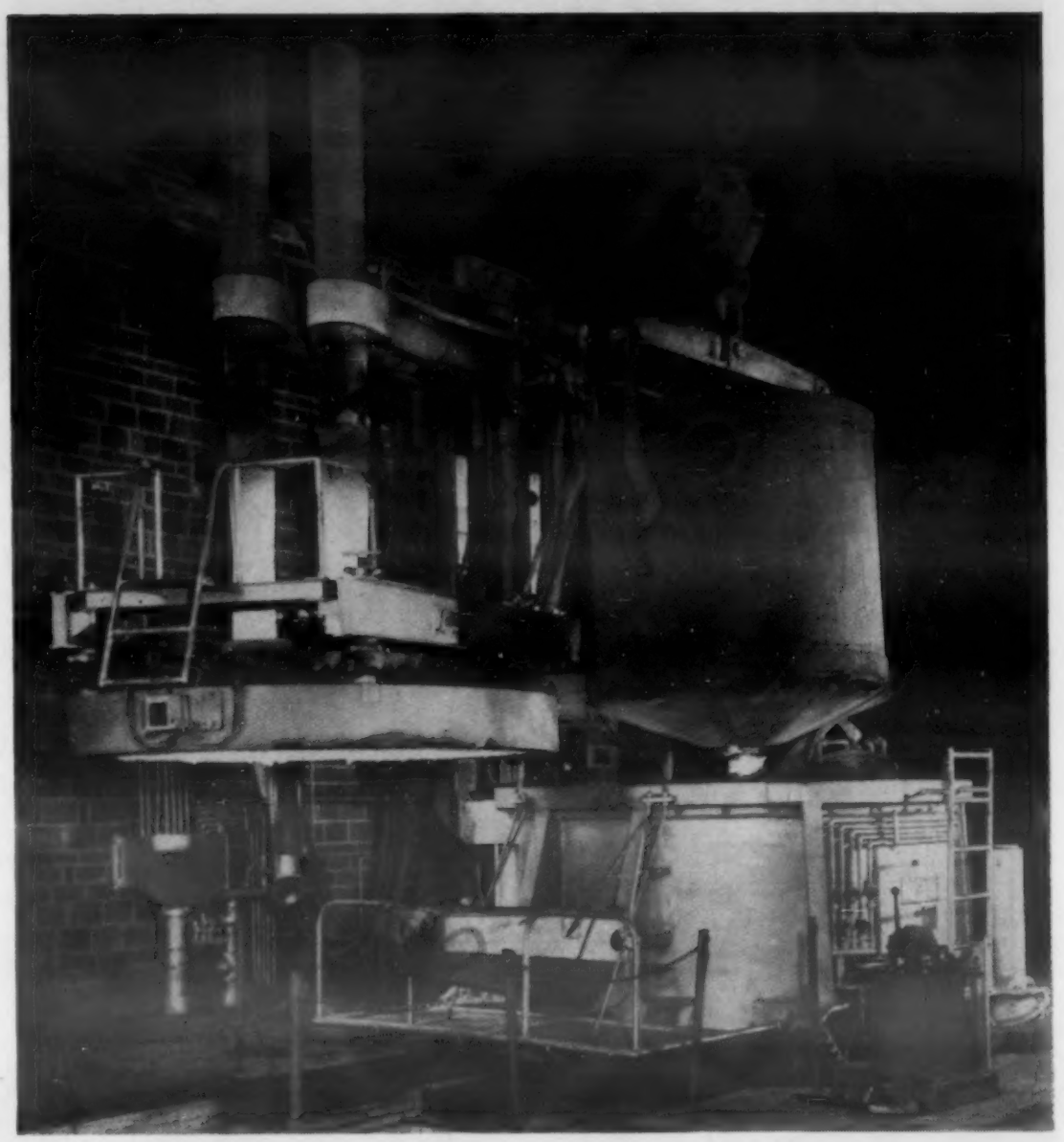
Piercing and Blanking Silicon Sheet with Liquids

An investigation conducted to determine the practicability of using a liquid instead of metal punches to produce blanks from silicon sheet steel has been concluded with successful results by engineers of *General Electric's Works Laboratory*.

As opposed to the ordinary methods of using a metal punch and die, this method substitutes a column of oil for the punch. The oil can be effectively channeled back and reused, eliminating the use of metal punches, which are worn out rapidly on silicon sheet steel.

It is possible through this method to use soft, unhardened steel dies, which cannot be done with the conventional metal punch. The engineers have determined that for each particular size and thickness of steel, it is necessary to calculate the particular impulse force to achieve a satisfactory blank.

The development of this method, while still in an experimental stage, has indicated that satisfactory blanks can be made.



ONE of the biggest advantages of Moore Rapid Lectromelt Furnaces, like the Size OT Lectromelt pictured above, is the large production economies provided by the top charge feature. For top charging sharply reduces the down time of Lectromelt furnaces and cuts the labor costs of charging. Also, actual operation data shows that refractory maintenance is reduced and that fewer electrodes and less power are consumed per ton of production with Lectromelt furnaces.

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EVERLASTING FASTENINGS

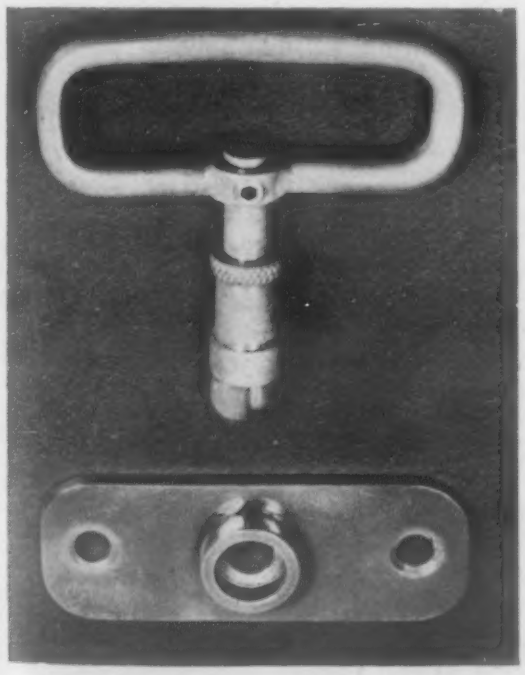
New Materials and Equipment

High Strength Fasteners Are Self-Locking

Self-locking fasteners that are vibration-proof and mechanically shock-proof, and that have a variety of uses in industry are being produced by *Interlock Corp.*, 1060 Broad St., Newark 2, N. J. The fasteners operate on a simple push-pull system. The plug part of the fastener locks upon straight insertion into the mating fixture.

This fastening system is applicable to both round and flat-pin plugs and they can be made in any given size. Self-locking plugs of less than ¼-in. total length but capable of withstanding an 80-lb. pull are being used for printed circuits, hearing aids, etc. On the other hand, a fastener is being designed for use in deck arrestor gear for aircraft carriers with a strength of over 90,000 lb.

Another typical use is as an upper berth strap holder in pullman cars. In this application the base plate is screwed to the ceiling and the strap connected to the shackle. Attached to the shackle is the basic unit. The tensile strength of this design is over 5000 lb.



This self-locking connector is being used in railroad cars as an upper berth strap holder.

Automatic Selective Hardening Equipment for Cylindrical Parts

Continuous selective hardening of cylindrical parts at feed rates to 6 in. per sec. is possible with the radio-frequency hardening system recently developed by the *Westinghouse Electric Corp.*, E. Pittsburgh. Operation can be made completely automatic when the cylindrical parts are of such design that they can be hopper-fed into an automatic loading device. When the work has been turned, milled or drilled so as to necessitate orientation to insure hardening in the proper places, the magazine of the automatic loading device must be manually loaded. After hardening, parts can be moved to the next production step via conveyor belt.

The equipment consists of three major components: automatic loading device, horizontal rotating scanner, and industrial radio-frequency generator. The automatic loading device consists of a magazine, designed to accommodate a particular cylindrical part properly oriented (if orientation is unnecessary a hopper can be substituted); a gate release, solenoid-operated to drop the work pieces in succession on a conveyor belt; and a conveyor belt to deliver work to the in-feed of the scanner.

The horizontal rotating scanner feeds the work through a work coil and spray quench assembly. Uniformity of case depth is obtained by controlled feed; concentricity of the case is insured by positive guide and rotation of the work about its longitudinal axis.

The industrial radio-frequency generator used with this equipment is a standard Westinghouse 10-kw., 450-kc. generator. Larger or smaller units can be used, depending upon the diameter of the work cylinder and the feed desired.

This equipment can be used to harden a wide variety of cylindrical parts in any desired pattern. Automatic selection of the proper electronic control for any particular part is made by a multi-prong plug, attached to the magazine for that part. The plug is wired so that the proper electronic circuit components are set up immediately when the plug is inserted.

This equipment can be adjusted to handle shafts within the following limits: length, 2 to 16 in.; dia., ⅜ to 2 in.; feed, to 6 in per sec., depending on the diameter of the work shaft and the power output of the generator.

● Several new uses for expanded metal have been announced by the *Penn Metal Co.*, Boston, Mass. One of the applications is self-service carts, where expanded metal provides a sturdy light-weight material for the baskets.

New Materials and Equipment
(CONTINUED)

Tube Ends Formed Rapidly in New Automatic Machine

A new tube forming machine that requires only 10 sec. to close completely the end of a 4-in.-dia. tube with ¼-in. wall thickness has been announced by the *Federal Machine & Welder Co.*, Warren, Ohio.

With the use of removable dies, this general purpose machine is suitable for a variety of job applications. Once the machine has been initiated by a push button at the operating station, the forming cycle is fully automatic. For short runs of special work, manual operation is provided, controlled by means of a selector switch, with separate push buttons for control of the clutch, chuck, and current initiation. A hand lever, in this case, controls the platen traverse.

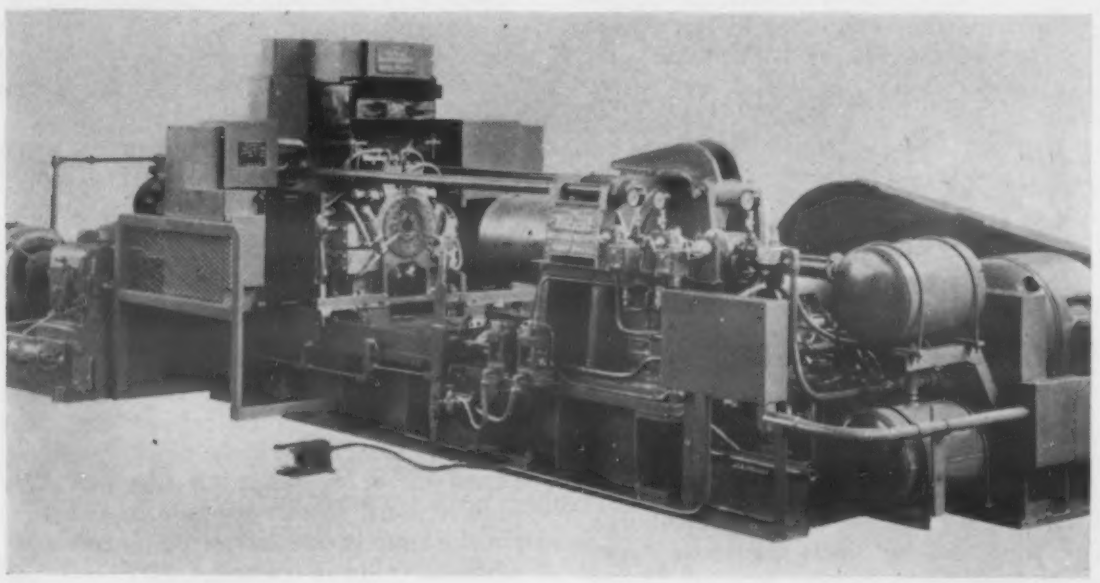
Brass, aluminum, copper, carbon steels, and most alloy steels, including stainless, are being successfully worked by the process, and experiments indicate that other metals also will lend themselves to this new metal-working technique.

The traverse speeds are infinitely variable from 0 to 100 in. per min., and the 8-step spindle speed ranges from 40 to 150 rpm. The three-segment die and three transformers permit equal loading of each phase of the conventional three-phase system, thus providing economical operation due to the lighter electrical demand.

Accurate control of forming temperatures provides even heating which prevents work hardening or formation of strain flaws, thus eliminating annealing and post-heating normally required by other methods.

The quality of the product formed is also accurately controlled, producing scale-free, smooth surfaces, no porosity, no twisting of the tubing during forming, and the metallic structure of the work kept within controlled limits.

Although generally built in nominal sizes to accommodate work ranging in diameter from ¾ to 4 in., 4 to 8 in., and 8 to 16 in., machines can be built for working tubing of almost any diameter or wall thickness.



A new metal-working technique is used in this machine designed to form tube ends.

Bench-Type Electric Furnaces for Heat Treating Small Parts

A new series of bench-type electric furnaces has been announced by the *Thermo Electric Manufacturing Co.*, 493 W. Locust St., Dubuque, Iowa. In these furnaces, designated Series 1500, current input can be regulated anywhere from 5 to 100% time "on," and any desired temperature from 350 F to maximum can be selected and held. The furnace can be operated continuously at temperatures up to 1650 F, and intermittently to 1900 F. The instrument panel also houses an indicating pyrometer calibrated in both Fahrenheit and Centigrade scales, a toggle switch and neon signal light.

These furnaces are especially suited for laboratory work such as ashings, ignitions, fusions, process control, etc., and are also excellent for hardening and tempering small steel parts and tools.

Heating elements are embedded in refractory plates forming the sides, top and bottom of the heating chamber to insure even distribution of heat, protection against physical damage, and to minimize oxidation. The top and bottom plates are interchangeable, as are also the sides, and any plate can be replaced without dismantling the furnace.

The furnaces are built in two chamber sizes: 4 in. wide, 3½ in. high, 4½ in. deep, and 4 in. wide, 3½ in. high and 9 in. deep. Separate models are supplied for operation on 115 and 230 v.

● An automatic power screw driver that drives up to 30 screws per min. has been developed by the *Reed-Prentice Corp.*, Worcester, Mass. A feed mechanism feeds screws one at a time from the hopper to the driver. One movement of the trigger automatically delivers a screw to the power driver, where it is held by a set of jaws. By pressing forward on the air gun the screw is driven into the workpiece. The unit can handle self-tapping machine or wood screws from No. 4 to 10, up to 1¾ in. in length, either slotted, recessed or Phillips head.

Power Saws for Cutting Nonmetallic Materials

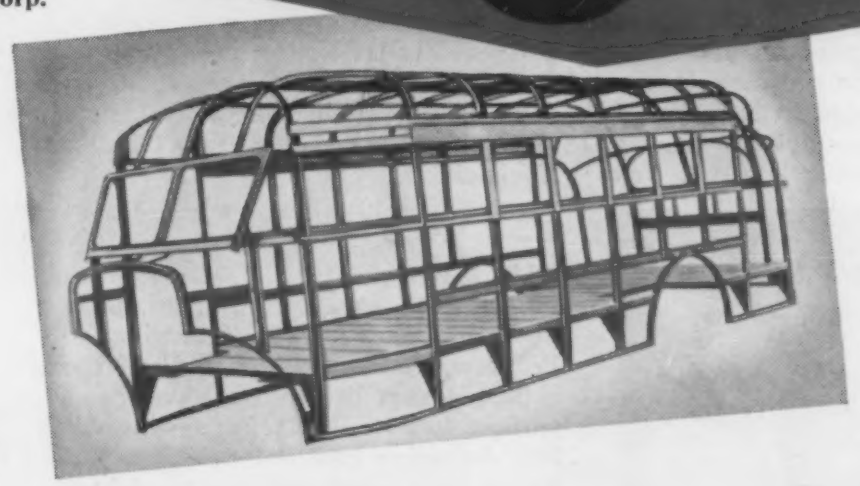
A series of saws designed for cutting nonmetallic materials such as glass, porcelain and masonry materials has been announced by the *Martin Fireproofing Corp.*, 2200 Military Rd., Buffalo 7, N. Y.

Some of the features of this equipment include: (1) a cutting table that can be adjusted for cutting material of varying thickness; (2) all working parts of the blade assembly function as a single unit, mounted on a pivoted arm; (3) the frame is of angle iron; and (4) the saws are portable.

To meet the various cutting needs, some of the saws are designed for dry cutting while others are designed for both wet and dry cutting. The latter type can be changed over quickly from one method to the other. For wet cutting the saw utilizes a self-priming pump and water jets spraying against the blade.

FRAMED and COVERED with safety

Pictures courtesy of Oneida Products Corp.



The greater strength and toughness of N-A-X HIGH-TENSILE steel permits weight savings of up to 25% in section—and still affords maximum protection against injuries from traffic accidents.

Its superior fatigue-resistance and excellent weldability prolongs this safety-factor . . . reduces maintenance costs over more miles and under all conditions.

If you manufacture a product requiring high strength, toughness and good weldability, it will pay you to investigate N-A-X HIGH-TENSILE.

MAKE A TON OF SHEET STEEL GO FARTHER
Specify—
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How the right adhesive cut production cost 75%

Old method took 10 minutes — 3M Adhesive method takes 1 minute for this brace and splint manufacturer

3M ADHESIVE IS BRUSHED ON METAL —second worker smooths felt into place *using only hand pressure.* Entire operation is completed in less than 1 minute—a better product results. No matter what fastening method *you* now use for your product, there's a good chance to save money if you switch to an adhesive. Send for free copy of "3M Adhesives in Industry" Write our Adhesives and Coatings Division in Detroit, Dept. MM-849.

OLD METHOD OF ATTACHING FELT padding to metal humerus splints made by Zimmer Manufacturing Co., Warsaw, Indiana. This method took skilled worker 10 minutes, gave uneven surface to felt. Replacing sewing with 3M Adhesive EC 104 drastically reduced both labor cost and production time for this manufacturer of modern fracture equipment, splints and braces.

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New Materials and Equipment

New Nonmetallic Materials for Many Uses

Phenolic Molding Powder

Development of a phenolic molding powder which is claimed to have outstanding heat resistance and improved gloss and surface finish has been announced by the *Monsanto Chemical Co., Plastic Div.*, Springfield, Mass. This new molding powder, designated Resinox 10231, was developed to meet the demand for a phenolic powder that withstands extremes of thermal shock and still retains a high degree of gloss.

In company tests, the plastic has withstood exposure to temperatures ranging from 400 to 500 F for more than 100 hr. In another test, the material was transferred immediately from room temperature to a hot oven without any evidence of the blistering that usually results in tests of less resistant material. In addition, molding properties are said to be improved. It is less critical to mold and has established a fast cure cycle.

Laminated Phenolic Punching Stock

The addition of laminated phenolic punching stock to its line of fibrous structural and insulating materials has been announced by the *Rogers Corp.*, Manchester, Conn. The stock can be supplied in standard thicknesses as sheet or punched parts to meet NEMA specifications XP and XXP.

Employing the beater addition process, the company uses its own raw materials. Special formulations can be produced to meet special requirements, including combining a melamine cover sheet with the basic phenolic stock. Complete tool, diemaking and fabricating equipment is also available for production of punched pieces.

Electrically Conductive Laminated Plastics

Laminated plastics containing conductive material which enables paint application to surface areas by the electrostatic spraying process are being produced by the *Panelyte Div., St. Regis Paper Co.*, 230 Park Ave., New York 17. The laminates were developed jointly with *Servel, Inc.*

Servel now paints all refrigerator parts—metallic and plastic—electrostatically. Materials to be sprayed pass through a field charged with high voltage static electricity. Magnetism attracts paint particles, sprayed under low pressure of 20 lb. to flat as well as rounded surfaces of the refrigerator parts, producing equal dispersion of paint. Upwards of 40% of paint normally wasted is said to be saved.

Graphite-Filled Nylon

Graphite-filled nylon in the forms of rods, cylinder and strip is now commercially

It can show you the heartbeat of a car radio—

You could cover pages with calculations about a car radio vibrator. You could fill sheets with figures on inertia and elasticity of its vibrating elements—and yet not be sure exactly how the rapidly moving parts do behave in action.

This is where high speed movies come in—the kind of "slow motion" you get from the Kodak High Speed Camera. It's a simple, direct means to record and study high speed repetitive mechanical motion . . . the only way to see dynamically what happens in non-cyclic high speed action.

The Kodak High Speed Camera can take a second of action and spread it over three minutes. It can put flash marks along the side of the film that time the motion accurately. Its optical system gives the extra picture sharpness you need to see a vital point clearly.

This camera is a single unit with one motor, complete in itself and easy to operate. If you would like to know how it works and how it can help you, send the coupon.

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SPEED ALLOY

A NEW Time Saver Steel

for "these times"

This plastic mold, with yokes of Speed Alloy and hardened tool steel inserts, was made by Chicago Mold Engineering Co. Yokes were rough machined, then normalized, then finish machined, pack carburized, oil quenched and drawn at 450°F. Hardness of 58 Rockwell C resulted.

If you're tired of wearing down pencil points figuring jobs, Speed Alloy Hot Rolled Alloy Steel Plates are the answer. Users are calling it "the most economical mold and die steel available." Bridges the gap between carbon and tool steels. Deep hardening properties (surface hardness in excess of 40 Rockwell C, core hardness up to 37 Rockwell C, depending upon section, are typical) result from the addition of chromium and molybdenum, permitting use where relatively high compressive strengths are required.

Speed Alloy gives real ease of machining with economical high polishing of surfaces at varying hardnesses. Essentially an oil hardening steel, a wide range of physical properties are obtainable by varying heat treatments, allowing wide diversity of use ranging from zinc die casting dies and machined parts to plastic compression molds. Ask for Bulletin 905.

Speed Alloy plates stocked in widths up to 72" and thicknesses to 6" by Speed Steel distributors, which can be flame cut to specifications, an advantage not obtainable in competitive steels.

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SPEED STEEL PLATE DIV.
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Passaic County Steel Service, Inc., Paterson, N. J.
Horace T. Potts Co., Philadelphia—Baltimore

New Materials and Equipment

available from the *Polymer Corp. of Pennsylvania,* Reading, Pa. In addition to being less costly than unfilled nylon, the new material, called Nylatron G, is said to have better wear resistance and improved frictional properties.

The material is useful where a combination of rubbing and impact is involved, or where normal lubrication is impossible. Particularly well suited for use as dry bearings, the filled nylon can also be used

Forms in which graphite-filled nylon is now available.

for cams, cam followers, gears, washers, oil seal rings, valve and pump packing, etc.

This new material is furnished in a range of rod diameters from 0.100 to 2¾ in. in cylinders, from 2- to 7-in. O.D. with varying wall thicknesses, and in strip from 0.010 to 0.090 in widths up to 2 in.

Finishing Resin

A new class of resins for use in the manufacture of surface coatings has been announced by the *Bakelite Corp.,* 30 East 42 St., New York. The resins are oil modified styrene copolymer solutions and are designated as Bakelite C-10 resins. Two types are currently available, BJS-501 and BJS-502.

BJS-501 is suited for interior architectural finishes, such as trim and wall surfaces in homes, offices and other buildings.

Enamel finishes that air-dry as fast as lacquers can be made from the resin BJS-502. They are being used for toys and farm implements where it is an advantage to be able to handle such items 8 to 10 min. after spray application. Baking-type enamels based on BJS-502 offer great usefulness in meeting short baking cycles. For example, enamels will bake to a Walker-Steele hardness of 137 sec. in 30 min. at 250 F. At 300 F, such enamels bake to a hardness of 141 sec. in 20 min. The resin also has good stability, suspension of pigments and color retention.

New Natural Rubber Compound

The development of a new gum-base natural rubber compound that is odorless, tasteless, and chemically pure has been announced by the *Stalwart Rubber Co.,* 165 Northfield Rd., Bedford, Ohio. This new compound is useful in food processing and chemical processing applications that require purity of all the materials that come into contact with the product.

The compound will withstand temperatures of 225 F for prolonged periods of

MEEHANITE® CASTINGS Provide Stamina to American Laundry Machinery Products

ALL UNITS built by American Laundry Machinery Co., Rochester, N. Y., are designed to incorporate the "better property" characteristics of Meehanite castings. The American Notrux Extractor illustrated is a good example offering users increased efficiency and a smooth, high-speed machine which will provide long, uninterrupted service.

Typical of the important Meehanite parts are the following:

1. Curb and Floor Base.
2. Legs.
3. Motor Bracket.
4. Basket Comb.
5. Sheave and Brake Drum.
6. Bearing Housings.

The variety of these parts and their important functions are indicative of proper design analysis and the recognition that only through the assurance of quality castings can all service requirements be met.

Your equipment can take advantage of the uniformity and dependability built into Meehanite castings.

For further information write for the Meehanite Handbook, 67 pages of important engineering data, to any of the foundries listed.

MEEHANITE FOUNDRIES

American Brake Shoe Co. — Mahwah, New Jersey
The American Laundry Machinery Co. — Rochester, New York
Atlas Foundry Co. — Detroit, Michigan
Banner Iron Works — St. Louis, Missouri
Barnett Foundry & Machine Co. — Irvington, New Jersey
H. W. Butterworth & Sons Co. — Bethayres, Pennsylvania
Continental Gin Co. — Birmingham, Alabama
The Cooper-Bessemer Corp. — Mt. Vernon, Ohio and Grove City, Pa.
Crawford & Doherty Foundry Co. — Portland, Oregon
Farrel-Birmingham Co., Inc. — Ansonia, Connecticut
Florence Pipe Foundry & Machine Co. — Florence, New Jersey
Fulton Foundry & Machine Co., Inc. — Cleveland, Ohio
General Foundry & Manufacturing Co. — Flint, Michigan
Greenlee Foundry Co. — Chicago, Illinois
The Hamilton Foundry & Machine Co. — Hamilton, Ohio
Johnstone Foundries, Inc. — Grove City, Pennsylvania
Kanawha Manufacturing Co. — Charleston, West Virginia
Koehring Co. — Milwaukee, Wisconsin
Lincoln Foundry Corp. — Los Angeles, California
E. Long Ltd. — Orillia, Ontario
Otis-Fensom Elevator Co., Ltd. — Hamilton, Ontario
The Henry Perkins Co. — Bridgewater, Massachusetts
Pohlman Foundry Co., Inc. — Buffalo, New York
Rosedale Foundry & Machine Co. — Pittsburgh, Pennsylvania
Ross-Meehan Foundries — Chattanooga, Tennessee
Shenango-Penn Mold Co. — Dover, Ohio
Smith Industries, Inc. — Indianapolis, Ind.
Standard Foundry Co. — Worcester, Massachusetts
The Stearns-Roger Manufacturing Co. — Denver, Colorado
Traylor Engineering & Mfg. Co. — Allentown, Pennsylvania
U. S. Challenge Co. — Centerville, Iowa
Valley Iron Works, Inc. — St. Paul, Minnesota
Vulcan Foundry Co. — Oakland, California
Warren Foundry & Pipe Corporation — Phillipsburg, New Jersey

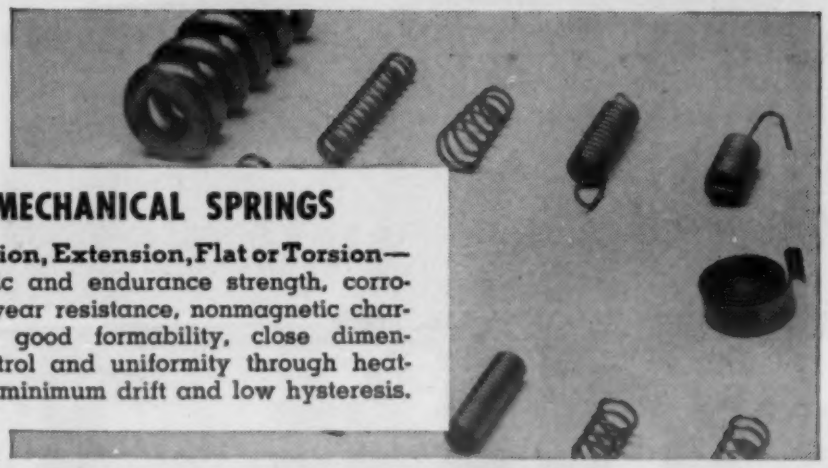
"This advertisement sponsored by foundries listed above."

Meehanite® NEW ROCHELLE, N. Y.

Can You Use These Properties of

BERYLLIUM-COPPER?

Check your design problems against these advantages of BERYLCO 25S

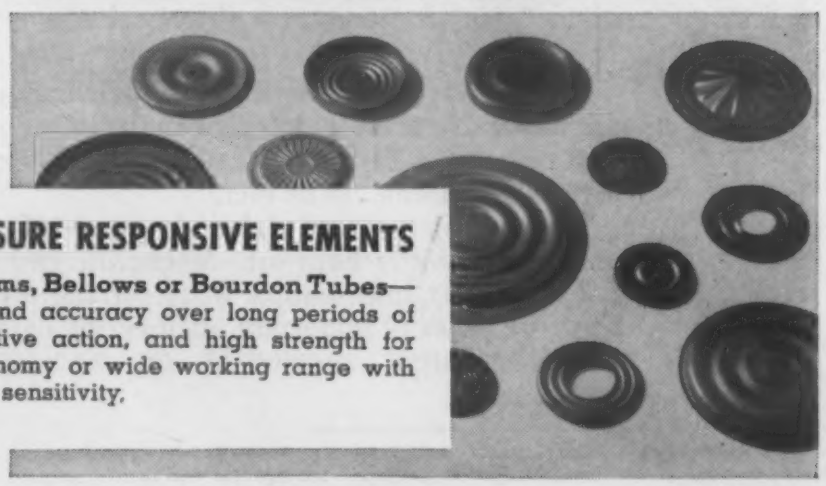


IN MECHANICAL SPRINGS

Compression, Extension, Flat or Torsion—high elastic and endurance strength, corrosion and wear resistance, nonmagnetic characteristics, good formability, close dimensional control and uniformity through heat-treatment, minimum drift and low hysteresis.

IN CURRENT-CARRYING SPRINGS

Connectors, Clips, Spring Contacts, or Switch Parts—the above properties plus electrical and thermal conductivity, resistance to relaxation at elevated temperatures, and the ability to maintain high and constant contact pressure.

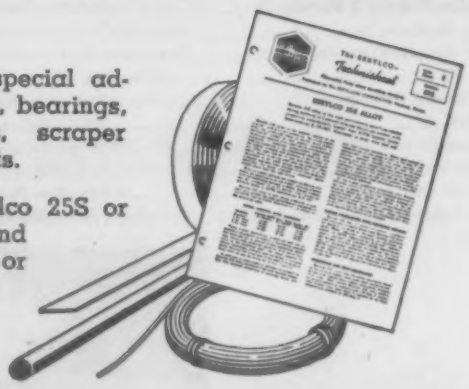


IN PRESSURE RESPONSIVE ELEMENTS

Diaphragms, Bellows or Bourdon Tubes—stability and accuracy over long periods of time, positive action, and high strength for space economy or wide working range with maximum sensitivity.

In addition, these qualities offer special advantages in the design of bushings, bearings, cams, washers, solenoid guides, scraper blades and screw machine products.

Write today for literature on Berylco 25S or if you have a design problem, send us full information with a drawing or sample of the part.



BERYLCO BERYLLIUM BERYLCO

The **BERYLLIUM CORPORATION**

Dept. 3, Reading 3, Pa.

New Materials and Equipment

time and temperatures up to 250 F for limited time intervals. It will not become brittle and will not crack at temperatures as low as 0 F.

The compound is easy to clean, and it will not retain food or chemical odors or tastes. It is suitable for such applications as gaskets, seals, washers and tubing on homogenizing equipment, pasteurizing ma-

Typical products fabricated from the new gum-base natural rubber compound.

chines, tank cars and trucks which transport milk and other liquids, distillation and dehydrating equipment, and candy making machines. Products fabricated from the compound can be molded, extruded, die-cut or lathe-cut into almost any required shape.

Corrosion Resistant Resin Material

A resin with resistance to acids, alkalis and solvents at temperatures as high as 325 F and with resistance to foot traffic and material handling has been developed by the *Carboline Co.*, 7603 Forsythe Blvd., St. Louis, Mo. The material consists of a liquid and powder which, when mixed, has a mortar-like consistency and is applied by trowel. It can be applied to vertical surfaces in layers of about 1/16 in. without sagging. When set, the material is hard, waterproof and impervious to most corrosives and solvents except nitric acid and sulfuric acid over 45% concentration.

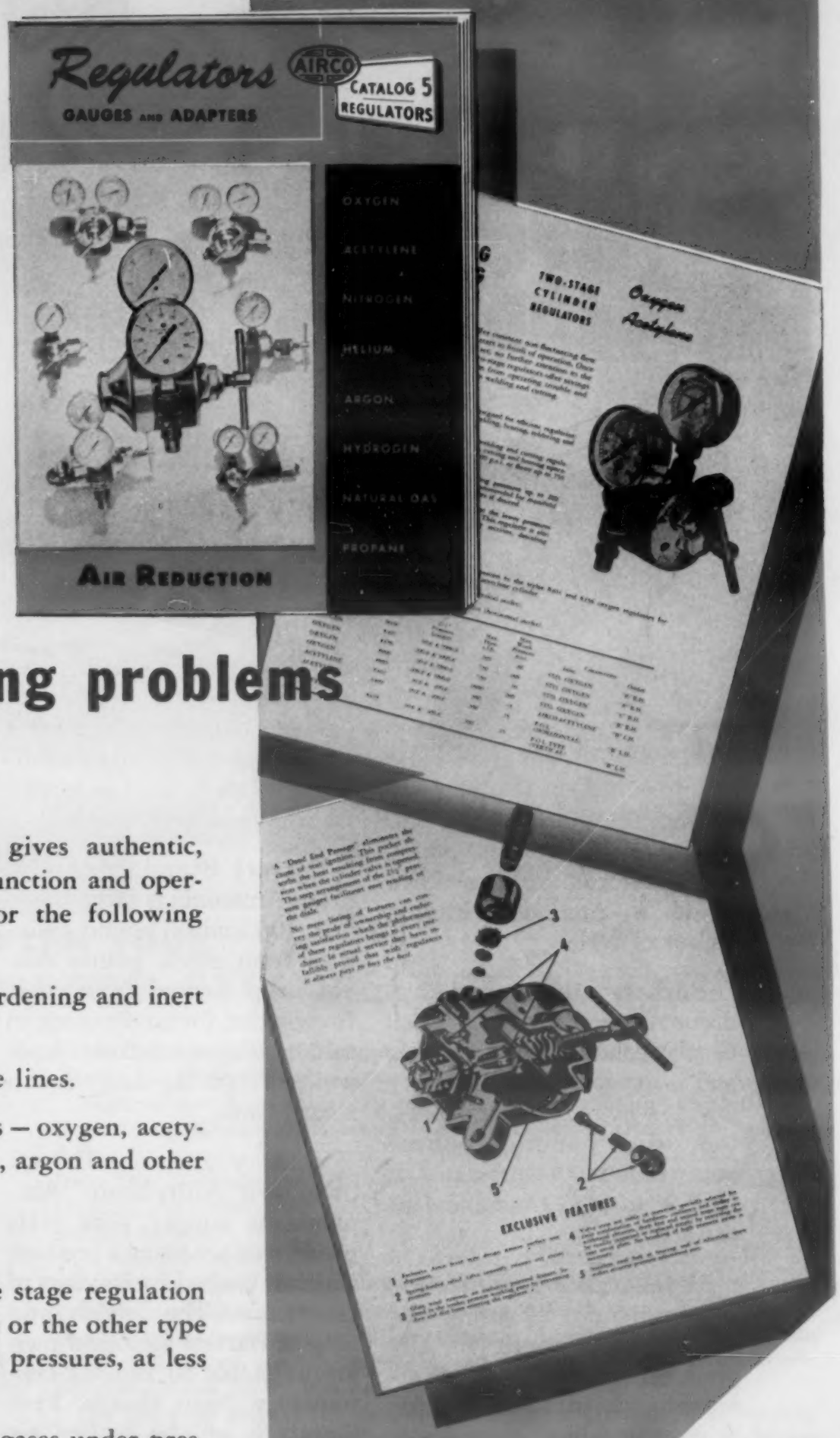
The new resin, called Carbo-Flex, is a black thermosetting resin that solidifies in from 2 to 28 hr. (depending upon temperature). It is very hard and relatively brittle, but it does have a flexibility of from 7 to 15%. Its compression strength is about 10,000 psi.

One trowel coat of 1/32 to 1/8 in. is sufficient for the average job. The material flows to a level surface on a horizontal plane. It has good adhesion to itself, so any desired thickness of lining can be built up. It can be applied at ordinary temperatures without special techniques.

● A new carbide tipped adjustable expansion blade for standard reamers and boring bars has been announced by the *Super Tool Co.*, 21650 Hoover Rd., Detroit 13. A wide range of standard sizes up to 4 in. are offered.

NEW HELPFUL GUIDE

to gas regulating problems



This new Airco Regulator catalog gives authentic, understandable information on the function and operating characteristics of regulators for the following types of service —

- for welding, cutting, heating, hardening and inert shielded arc welding.
- on cylinders, manifolds and pipe lines.
- for all types of compressed gases — oxygen, acetylene, nitrogen, hydrogen, helium, argon and other industrial gases.
- for use in the laboratory.
- dual stage regulation . . . single stage regulation — and a quick "reason why" one or the other type would give you desired uniform pressures, at less cost, for a particular job.

Everyone concerned with regulating gases under pressure will find use for this helpful catalog. It will save him time, effort and needless waste of money. It contains data regarding the proper regulator for any given type of job.

AIRCO AIR REDUCTION

Offices in Principal Cities

Headquarters for Oxygen, Acetylene and Other Gases... Calcium Carbide...Gas Cutting Machines Gas Welding and Cutting Apparatus, and Supplies...Arc Welders, Electrodes and Accessories

Send for this valuable, informative guide today! Fill in the coupon below.

Air Reduction
60 East 42nd Street
New York 17, N. Y.

Please send me a copy of your NEW helpful guide to gas regulating problems—Catalog No. 5.

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Firm_____

Address_____

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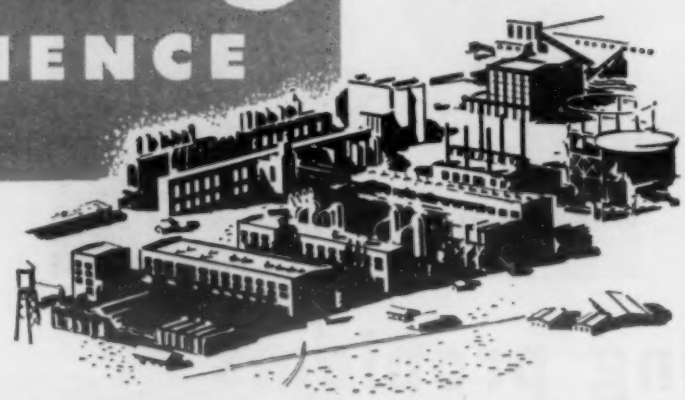
59 YEARS OF NH_3 EXPERIENCE



BARRETT Standard Anhydrous Ammonia was first manufactured in 1890. During the last 59 years, its dependable quality, consistent purity and uniform dryness have made it America's leading source of NH_3.

Barrett Standard Anhydrous Ammonia (*Refrigeration Grade*) contains 99.95% NH_3 and is oxygen free with a very low dew point. When dissociated, each pound produces approximately 34 cubic feet of hydrogen and 11 cubic feet of nitrogen.

Metallurgists are effecting real economies by using dissociated ammonia in the production of controlled atmospheres in furnaces for bright annealing, clean hardening, copper brazing, sintering, reduction of metallic oxides, atomic hydrogen welding, radio tube sealing and other metal-treating practices. Anhydrous ammonia also has unsurpassed qualities in nitriding of steel, used as ammonia gas or dissociated.

Barrett Standard Anhydrous Ammonia is available in 150, 100 and 50-pound cylinders from stock points conveniently located from coast to coast; or, for larger users, in tank car shipments from Hopewell, Virginia, and South Point, Ohio.

When you choose Barrett Standard Anhydrous Ammonia to supply your NH_3 needs, you are using a product which is backed by 59 years of experience. The advice and help of Barrett technical men are available to Barrett customers without charge. Free literature will be mailed on request.

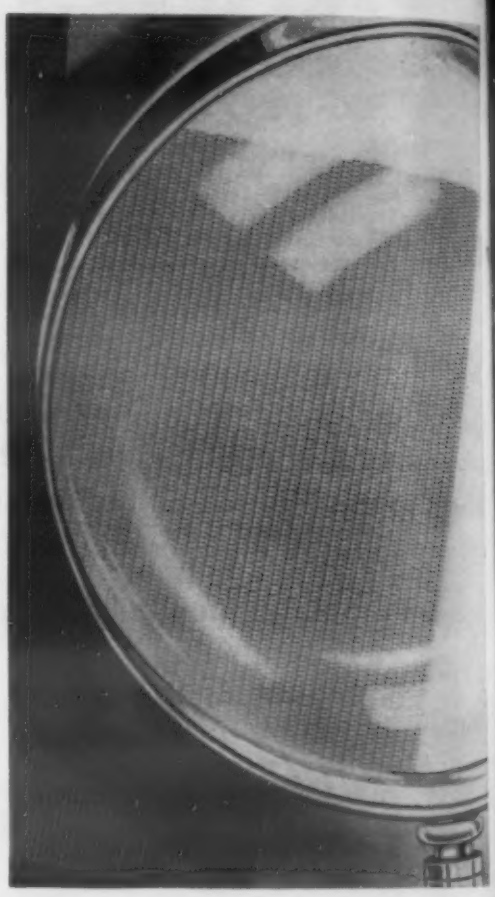
THE BARRETT DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street, New York 6, N. Y.

New Materials and Equipment

New Wire Cloth Provides Resistance to Corrosion

Filter cloth made from Hastelloy wire is now available from *John A. Roebling's Sons Co.*, Trenton 2, N. J. The cloth has high resistance to chemical corrosion by nearly all acids over a wide range of temperatures and concentrations.

For specific types of service, two different grades of filter cloth are available. One is made of alloy B which contains nickel, molybdenum and iron, and is especially resistant to most common acids including hydrochloric acid. The other, of alloy C, a nickel-molybdenum-chromium-iron alloy, is good for applications involving oxidation.



A magnified view of the corrosion resistant wire cloth.

Sealant Developed for Light Metal Castings

A new liquid resin for sealing porous, light metal castings has been announced by the *General Electric Co., Chemical Dept.*, Pittsfield, Mass. The new material, called G-E Permafil, was developed to permit foundries to salvage castings which

HERE'S HOW...

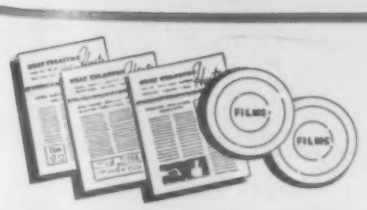
TO PLAN YOUR TOOLROOM HEAT TREATING DEPARTMENT

Published to assist those planning new or expanded heat treating departments. It's yours for the asking.

Material contained in this 24 page booklet, prepared by the Lindberg Engineering Company, is based upon years of experience in helping design hundreds of toolrooms . . . plus additional information gained from the 24-hour-a-day operating experiences of the toolroom heat treating department of the Lindberg Steel Treating Company, the world's largest.

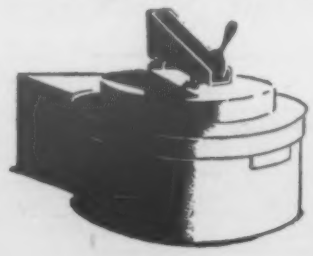
It helps arrive at total costs in advance • Shows recommended department layouts • Tells how to select furnaces of proper size • Gives prices of auxiliary equipment such as tongs, quench tanks, straightening presses, hardness testers, work benches, etc. • Contains loose template pages of furnaces, quench tanks, etc. and graph paper . . . a few seconds of scissor work shows you how your department will look.

To get your copy write or call your nearest Lindberg Engineering Company office or the Lindberg home office at 2451 West Hubbard Street, Chicago 12, Illinois.



Other helps for Heat Treaters. "Heat Treating Hints"—a publication covering the practical side of heat treating with strictly "how to do it" articles. Available on request.

"Heat Treating Hints", two movies, (color and sound) bring to the screen practical articles from the printed "Heat Treating Hints". Ideal for technical associations, plant showings, schools. Write for Bookings.

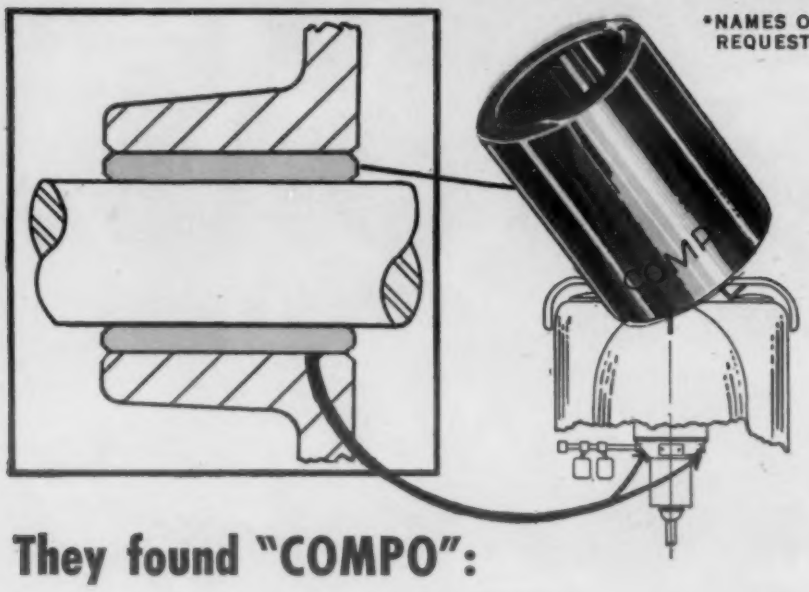
LINDBERG  FURNACES

"COMPO"
OIL-RETAINING
POROUS BRONZE BEARINGS

Why did 3 large Automobile Manufacturers* *Switch to* "COMPO"

FOR CLUTCH RELEASE SHAFT BEARINGS?

*NAMES ON REQUEST.



They found "COMPO":

1. *Saved the cost of two grease fittings, the time for drilling and tapping, and eliminated the need for frequent lubrication.*
2. *Simplified design problems, speeded assembly and resulted in trouble-free operation and minimum maintenance.*

Made from pure metal powders, "COMPO" Bearings are die-formed to shape, alloyed at high temperatures, finished to exact dimensions, and vacuum-impregnated with lubricant. They can be depended upon for countless hours of trouble-free operating service. Self-lubricating qualities make them ideal for use in inaccessible spots. The lubricant is sealed in, free from dirt, and an even lubricating film is always present.

"COMPO," and other Bound Brook Bearings, are showing savings like these not only in other automotive applications, but wherever moving parts must run true, smooth and free from friction. Thousands of sizes can be made from existing dies; hundreds of sizes in stock for prompt shipment.

Whatever may be your bearing requirements, consult a Bound Brook engineer. Mail the coupon below today. *We've saved time and costs for others. We can do the same for you.*

Many types of structural parts can be made of "COMPO." On large volume requirements, their use effects great savings by eliminating machining normally needed to hold required tolerances.

BOUND BROOK OIL-LESS BEARING COMPANY

BEARINGS • BUSHINGS **WASHERS • PARTS**

BOUND BROOK, N. J. **ESTABLISHED 1883**

Bound Brook Oil-Less Bearing Co.
Bound Brook, N. J.

MM 8-49

☐ I would like to talk to one of your engineers about_____

_____

☐ Please send me a copy of your "COMPO" Bearing Stock List.

Name_____ Title_____

Company_____

Street_____ City_____ State_____

New Materials and Equipment

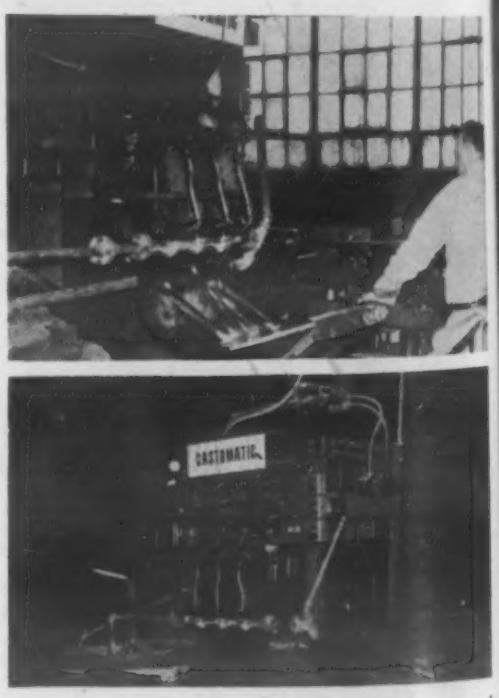
would otherwise be rejected because of porosity, and to permit their use on applications involving oil or vapor pressures.

A polyester-type resin, the compound converts to a tough clear solid, free of voids, through the action of catalysts and heat. Castings are sealed by vacuum impregnation and a subsequent short oven bake. The material is said to have good storage life under recommended conditions.

Machine-Cast Bar Solders Have Improved Properties

A new type tin-lead bar solder has been announced by the *Federated Metals Div., American Smelting & Refining Co.*, 120 Broadway, New York. The solders, known as Castomatic, are manufactured by patented casting machines that operate on the die casting principle. It has been the accepted procedure in the metalworking industry to cast solder bars by hand. Although universally accepted, these bars leave much to be desired. The new equipment is said to eliminate the deficiencies of manual casting.

In the new method, the molten solder is contained in a completely closed system from melting kettle to mold. All operations



Pressure-cast solder bars with improved performance characteristics are produced on this equipment.

are automatic, and each step in the manufacturing cycle is timed by electronic controls.

Oxides in the metal are eliminated be-

Looking For An Answer to Heat-Treat CONVEYOR TROUBLES?

If you're bothered by these conveyor troubles:

- *Jumping the sprockets*
- *Pins "crank-shafting"*
- *Frequent replacement of defective links*
- *High maintenance cost*

. . . you'll find such troubles can usually be traced to improper engineering or inspection of the original conveyor parts.

For example, if dimensions on individual castings are not accurate, the driving drum or sprocket will exert an unequal pull on each line of links. This causes stretching. Pins often "crank-shaft". . . causing belt to "ride" on top of driving drum lugs, instead of engaging properly. This results in fracture of individual links and increased maintenance costs.

The cure for such troubles rests on careful engineering and production. Individual castings must be identical in length—so the belt will engage properly with driving drum, and no one link will be overstressed. Good design also provides close spacing between links for carrying small parts . . . and allows sufficient clearance to eliminate excessive wear.

Electro-Alloys has made a specialty of the precision engineering and production techniques required to produce conveyor belts of outstanding quality. We can show you *proof* that THERMALLOY high alloy conveyor parts give longer life, cut downtime and maintenance costs.

Call your nearest Electro-Alloys engineer. Or write Electro-Alloys Division, 1983 Taylor Street, Elyria, Ohio.

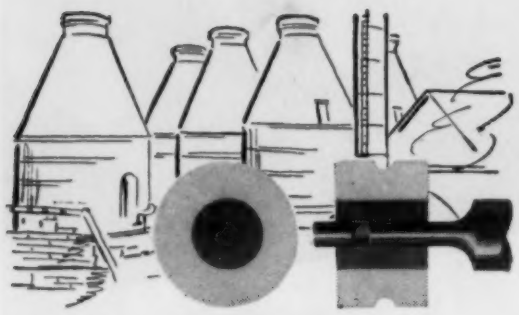
THERMALLOY resists temperatures up to 2200° F.

*Reg. U. S. Pat. Off.

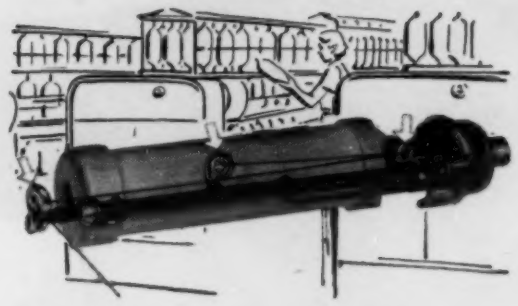
AMERICAN Brake Shoe COMPANY

ELECTRO-ALLOYS DIVISION
ELYRIA, OHIO

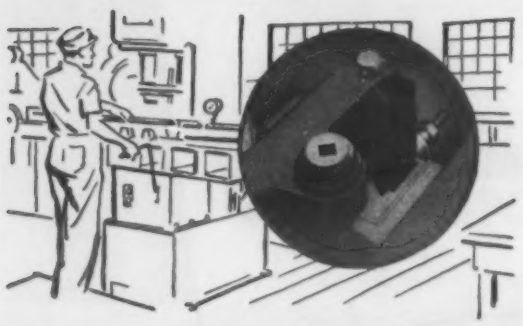
You find CARBOLOY CEMENTED CARBIDE doing the most amazing jobs!



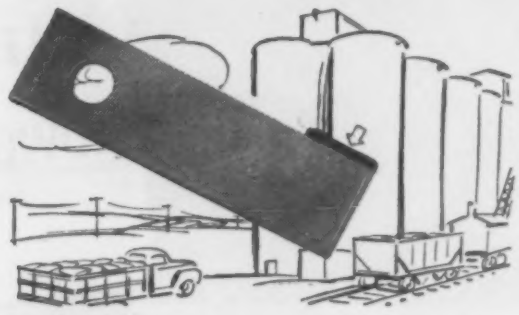
IN CERAMICS MANUFACTURING—dies of Carboloy Cemented Carbide are used to great advantage in moulds for highly abrasive ceramics materials. Through use of wear-resistant Carboloy inserts in moulds, one manufacturer boosted production from 700 to 100,000 pieces!



IN THE TEXTILE INDUSTRY—abrasive wool, nylon and other threads, continually rubbing against thread-eyes, *wore them down rapidly*. Carboloy thread-eyes, which replaced ceramic guides, *showed no signs of wear after a whole year of use*. They have lasted up to 100 times longer!



IN MACHINE TOOLS—bearing surfaces of cast iron and steel, on a grinding machine for grinding form tools with diamond wheels, had to be resurfaced every six months. After Carboloy Cemented Carbide was substituted, no wear signs had been detected after more than a year of continuous use.



IN FOOD PROCESSING (for cattle)—long-wearing Carboloy blades, in hammer mills used in processing livestock food, have greatly outlasted blades of finest steel which were previously used. And the Carboloy-equipped hammer mills are producing a more uniform and higher-quality feed.

If you have a "wear" problem . . .

SURPRISED to find Carboloy Cemented Carbide at work in such a variety of ways? Actually, these are only a few of the hundreds of unusual jobs this versatile metal is doing . . . and *well.*

Because Carboloy—*the hardest metal made by man*—has such high resistance to wear, design engineers in countless industries have found it the answer for licking abrasive, corrosive, or erosive wear on machines or parts. Nowadays, Carboloy is used for everything from dental drills to draw dies and from bushing inserts to brick mold liners.

If wear is causing excessive down-time and costly loss of production, if rejects are high or replacements too frequent, why not let Carboloy's engineers give you a hand with your problem?

It's a good bet they'll come up with a solution that will mean longer life and better operation for equipment or parts . . . and real savings for you.

Delay in taking action may cost you time and money. So, if you have a wear problem, or a product or part that might be benefited by Carboloy, put in that call for a Carboloy expert.

CARBOLOY COMPANY, INC.
11161 E. 8 Mile Street, Detroit 32, Michigan

THERE'S LONGER LIFE WHERE THERE'S
CARBOLOY®
CEMENTED CARBIDE

THE HARDEST METAL MADE BY MAN

New Materials and Equipment

cause the system is closed to air during melting and casting. As a result, the solders have uniformity of composition, improved fluidity, and easier working properties. Segregation of the solder elements is said to be virtually eliminated in these solders, thus insuring a uniform melting temperature from one end of the bar to the other, and adding to soldering ease and efficiency.

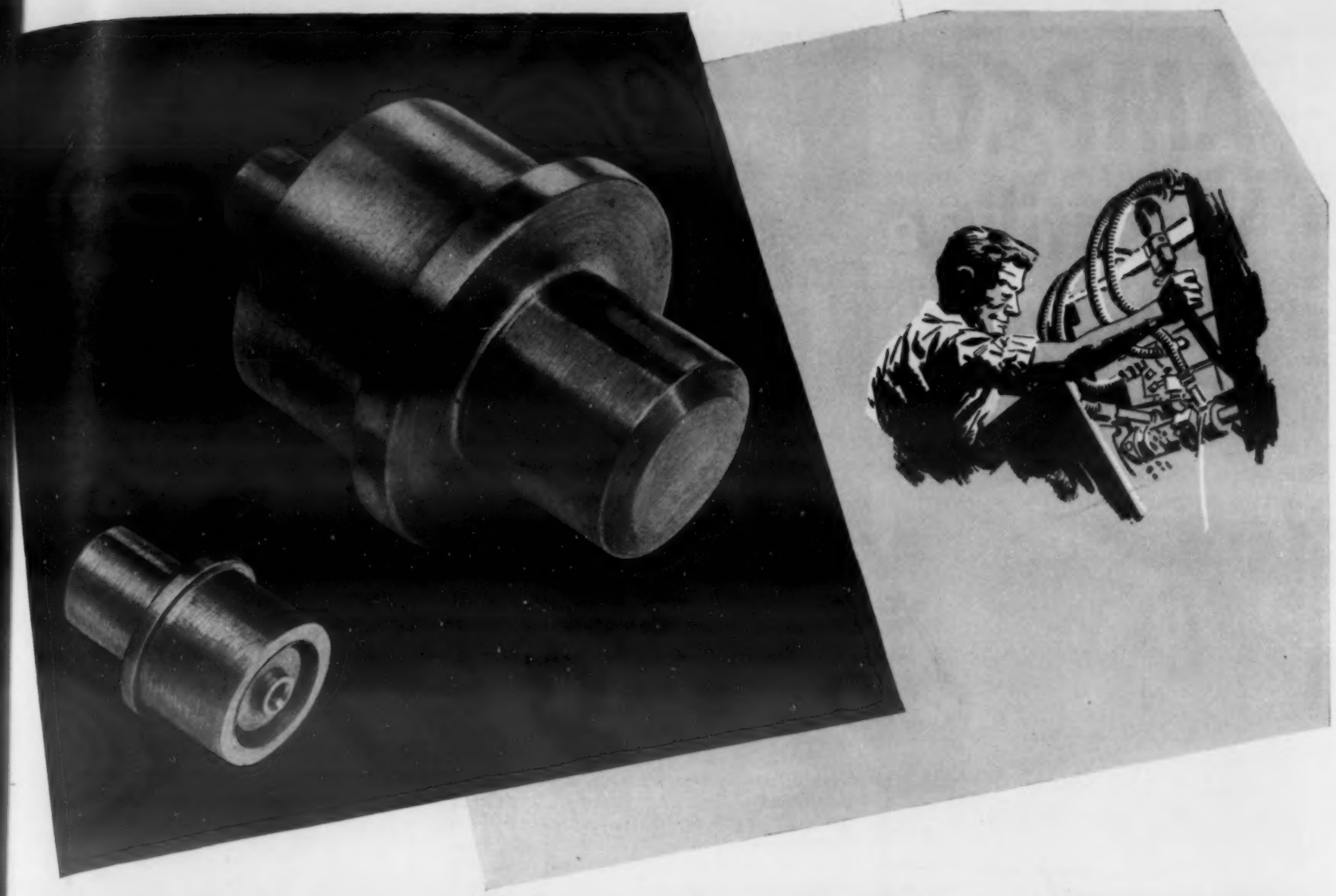
● Aluminum-bronze wear strips for use on boring bars and driving tools piloted in bushings are offered by *Scully-Jones & Co.*, 1944 S. Rockwell St., Chicago. These wear strips practically eliminate seizing and galling caused by high speeds, heavy loads, and adverse operating conditions. They are cast from Ampco Metal Grade 21, have a low coefficient of friction and good heat conductivity. The wear strips are available in 6-in. lengths and five standard sizes. The five standard widths are 3/8, 1/2, 5/8, 3/4 and 1 in.

New Microhardness Tester for Light Load Testing

A new Tukon microhardness tester has been introduced by the *Wilson Mechanical Instrument Co., Inc.*, 230 Park Ave., New York. Mechanically operated, it is useful in light load testing where there is not sufficient testing to warrant a fully automatic model.

The tester is made in both a floor and bench model. It applies loads of from 1 to 1000 gm., and can be used with either the Knoop or 136-deg. diamond pyramid indenters. Load is applied under dash pot control, speed of which can be varied from less than 0.40 in. per min. to as fast as testing permits without impact influencing the results. Both rate of application and duration of applied load can be controlled. A feature of this model is a special arrangement for removing the load without the operator having to touch the instrument until the indenter is out of impression.

Focusing the impression under the microscope is accomplished through the elevating unit with vernier adjustment. This arrangement eliminates the need for coarse and fine adjustment on the microscope. The load is applied in a novel manner, eliminating the necessity of bringing the elevating screw to any reference marks, trial settings, etc.



SHORT PARTS *with a* LONG FUTURE

...made of Republic COLD DRAWN ALLOY STEEL BARS

● In these ratchet wrench heads, as in countless other machined steel parts, strength, toughness, close tolerances and ease of machining are important requirements from both cost and quality standpoints. That's why they are made of Republic Cold Drawn Alloy Steel Bars.

Republic Alloy Steels are unsurpassed for resistance to wear, impact and fatigue . . . provide uniform response to hardening treatment. Their use, in many instances, means valuable cost savings—reduced maintenance and replacement costs, fewer repairs, lower operating expense. In cold drawn bar form, these same steels have a recognized reputation for fine surface finish, accuracy of section, close tolerances and UNIFORM MACHINABILITY—qualities which hold the key to lowest possible unit production costs.

Republic Cold Drawn Alloy Steel Bars are available in all popular analyses, in standard shapes and sizes, furnace treated to meet your specific requirements—annealed, normalized, heat treated, spheroidized, stress relieved or carbon corrected.

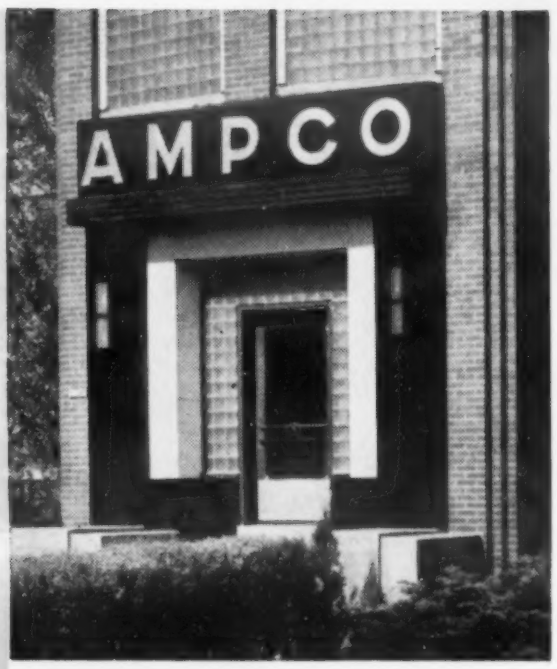
Republic metallurgists are ready now to help you secure maximum results . . . Write for further information.

REPUBLIC STEEL CORPORATION
Alloy Steel Division • Massillon, Ohio
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, New York

Republic COLD DRAWN
REPUBLIC STEEL
ALLOY STEEL BARS

Other Republic Products include Casing—Tubing—Line Pipe—Upset Studs, Bolts, Nuts and Rivets—Electrunite Boiler Tubes

AMPCO Versatility helps you Cut Costs



"AMPCO METAL"... a by-word in INDUSTRY — The COMPANY and...a PRODUCT of that company

35 YEARS OF PROGRESS... Founded in 1914 to produce sand castings made from AMPCO METAL... a hi-iron aluminum bronze, the Company has grown steadily and expanded its facilities and the scope of its activities to the point where it is now an organization specializing in the production of non-ferrous alloys and products made therefrom.

Produced under close laboratory control, Ampco aluminum bronze alloys are available as: *sand and centrifugal castings; extruded rod, tube and simple shapes; rolled sheet and plate; forgings; arc and resistance welding electrodes; machined parts; valves; pumps and fabricated assemblies.*

In addition to aluminum bronzes (still the major product) Ampco Metal produces, under the same laboratory control, many other copper-base alloys including: phosphor bronzes; tin bronzes; nickel bronzes; manganese bronzes and Ampco Beryllium-copper.

Ask an Ampco Field Engineer for further details... make full use of our engineering service.

1. Laboratory Control and Research.
2. Modern Sand Foundry for job or production work.
3. Centrifugal Foundry... producing castings weighing less than a pound to more than 6000 pounds.
4. Pouring billets for Extrusion Mill.
5. Machine Shop specializing in aircraft work.

FOR COMPLETE DETAILS —
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Dept. MA-8, Milwaukee 4, Wis.
Name.....Position.....
Company.....
Company Address.....
City.....(...) State.....
G-3

AMPCO® **AMPCO METAL, INC.**
MILWAUKEE 4, WISCONSIN

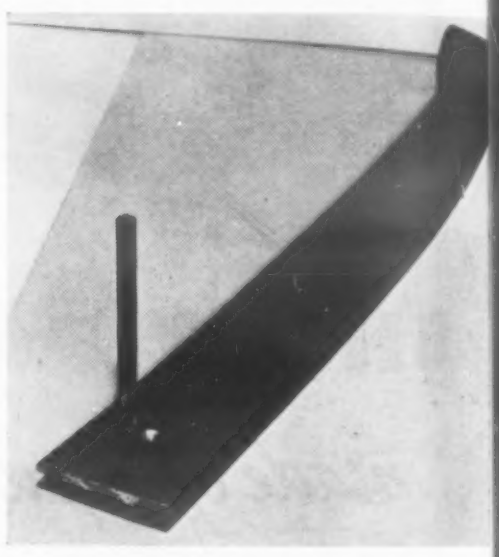
West of the Rockies, it's the Ampco West Coast Plant, Burbank, Calif.

New Materials and Equipment

Surface Hardening Compound Useful for Steel Tools and Dies

A new compound that rapidly surface hardens steel has been announced by *Doughty Laboratories, Inc.,* 307 E. 44th St., New York 17. The compound, known as Hard 'n' Tuff, has been tested on a 1020 carbon steel and has produced a hardness of 60 Rockwell C.

The hardening process involves heating the steel to a temperature of around 1700 F for a given time and then dipping or rolling the part in the hardening compound, after which the part is returned to the furnace and again heated. When the compound has fused in the steel, the part is removed and quenched in cold water.



The steel hardening compound is useful for hardening carbon steel drills such as the one shown here.

This compound is said to have many applications in industry. Some of its uses include hardening of chisels, drills and forming dies.

Brazing of Aluminum to Steel Accomplished by New Method

A practical and economical method of brazing aluminum to steel has recently been developed by *Salkover Metal Processing,* 321 Dixie Terminal Bldg., Cincinnati 2, Ohio. In addition to great strength and broad adaptability, the technique is reported to be simple and low in cost.

Possible applications include brazing of aluminum cooling fins to steel engine and compressor cylinders, and fabrication of assemblies in which the special properties of steel inserts are combined with light weight and corrosion resistant advantages of aluminum.

Portable waterworks

THAT'S "Scotch" WITH THE DOLLARS!

... Another example of what GEON polyvinyl materials can do

WHEN an orchard grows on a slope, or if the ground is gravelly, irrigation is tough, and costly too.

The irrigation hose you see here cuts costs dramatically because it's made of Geon resin, the polyvinyl material with so many advantages.

For example, the mirror-like interior finish of this hose cuts friction loss of the water flow. This permits using much less footage of costly, underground steel supply pipe. Six to eight sprinklers can be used per line—compared to three or four with ordinary hose.

Those are just a few of the advantages of this Geon-made irrigation hose. It is one-third to one-half lighter in weight than ordinary hose of comparable size. No kinks—ever. Sunlight will not break it down. Its brilliant color makes it easy to see.

This hose gets its remarkable qualities from Geon—the versatile material that makes wear-resistant upholstery, tough wire insulation, durable and beautiful flooring and, of course, garden hose.

These uses may start you thinking how Geon can improve your product —or perfect a new one. Geon materials can be extruded, calendered into film or used as a coating. Products of Geon can be made resistant to heat, cold, water, oil, aging and other damaging factors. Brilliant or delicate colors are easy to get.

We make no finished products from Geon polyvinyl materials. But we're ready to help you with your applications. For information or technical service, please write Dept. **R-8, B. F.** Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. In Canada: Kitchener, Ontario.

Resinite Super-Hose made by Resin Industries, Santa Barbara, California, as used at the T. C. Abbott Canyon Ranch, Carpinteria, California.

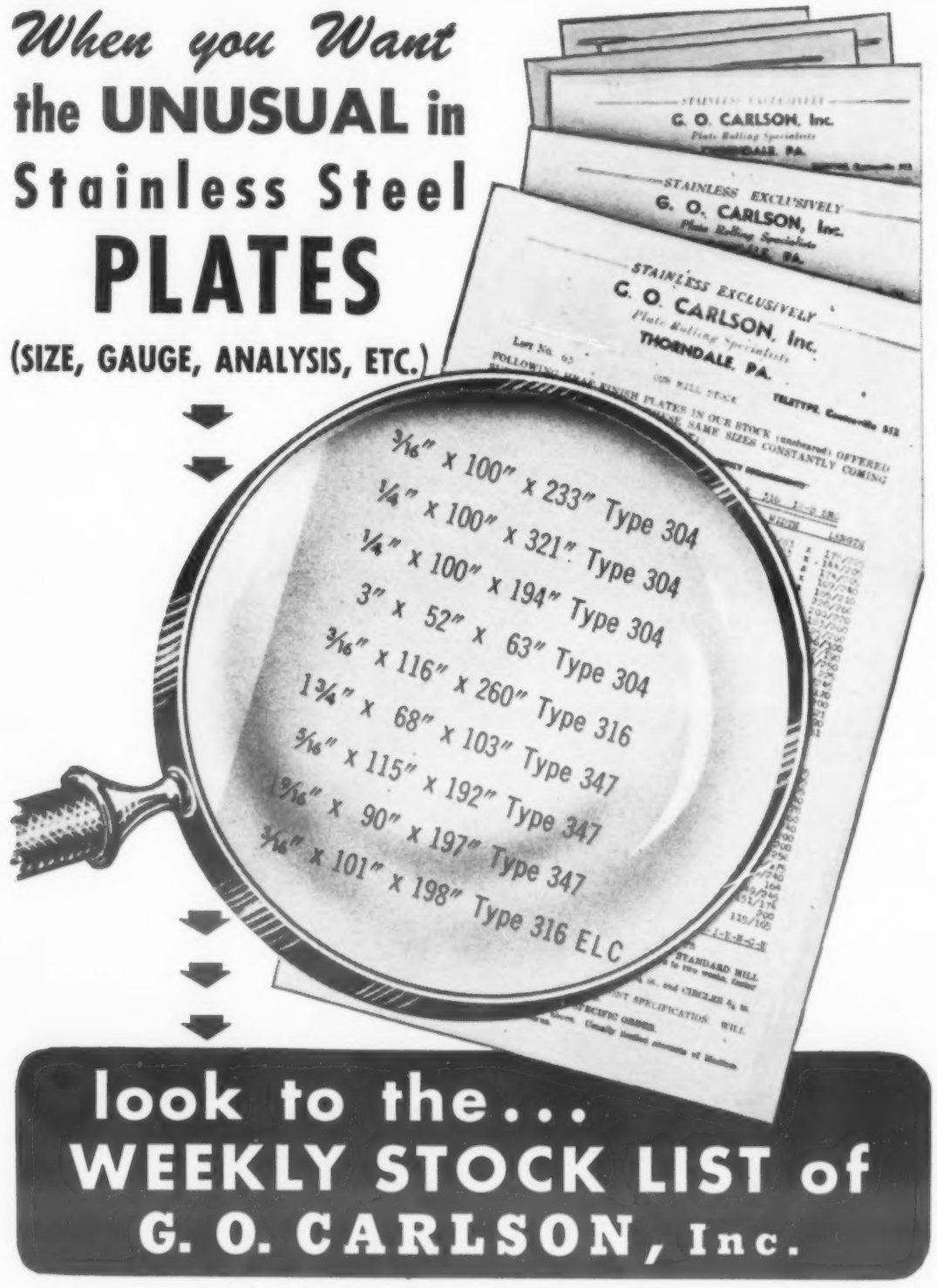
Geon
Polyvinyl Materials
* TRADE MARK OF B. F. GOODRICH CHEMICAL COMPANY

B. F. Goodrich Chemical Company

A DIVISION OF THE B. F. GOODRICH COMPANY

GEON polyvinyl materials • HYCAR American rubber • GOOD-RITE chemicals and plasticizers

When you Want
the UNUSUAL in Stainless Steel
PLATES
(SIZE, GAUGE, ANALYSIS, ETC.)


STAINLESS EXCLUSIVELY
G. O. CARLSON, Inc.
Plate Rolling Specialists
THORNDALE, PA.
3/16" x 100" x 233" Type 304
1/4" x 100" x 321" Type 304
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3/16" x 116" x 260" Type 316
1 3/4" x 68" x 103" Type 347
5/16" x 115" x 192" Type 347
3/16" x 90" x 197" Type 347
3/16" x 101" x 198" Type 316 ELC

look to the...
WEEKLY STOCK LIST of
G. O. CARLSON, Inc.

In addition to relatively standard or "usual" stainless steel plates in stock, G. O. Carlson, Inc. often lists out-of-the ordinary plates which are not normally available on quick delivery. Shown here are but a few of the many examples which appear in our stock lists. The G. O. Carlson, Inc. Weekly Stock List makes it possible to anticipate future needs and order Stainless plates to chemical industry standards "from stock", cut to pattern if desired.

We would be pleased to include your name on the list to receive this factual weekly reminder from G. O. Carlson, Inc. Our only business is Stainless Steel.

G. O. CARLSON, INC.

Stainless Steels Exclusively
200 Marshalton Road, Thorndale, Pa.
PLATES · FORGINGS · BILLETS · BARS · SHEETS (No. 1 Finish)
Warehouse distributors in principal cities

New Materials and Equipment

New Plastic Cement Has Many Applications

A new plastic cement has been developed for many uses by the *Hayes Research Co.*, 678 Massachusetts Ave., Cambridge 39, Mass. It is said to be capable of cementing many unusual materials together for the first time.

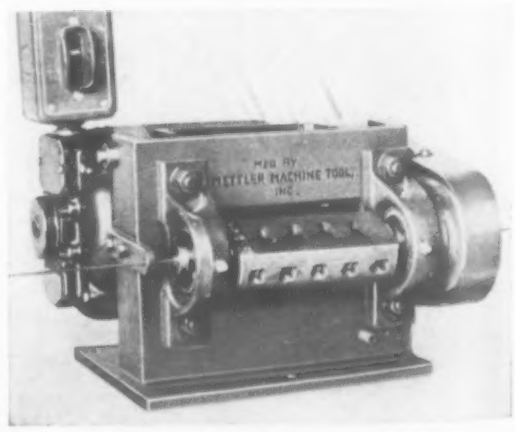
The adhesive, known as Dekadhese, is colorless and, therefore, is useful in applications involving invisibility and extreme clarity, such as the cementing of glass, acrylic and cellulose plastics. It is also cold-setting and fast drying, is said to remain permanently flexible, and does not crystallize or become brittle. The adhesive has high resistance to oil, gasoline, vermin, mould, water and moisture vapor. Its high dielectric strength makes it useful in electrical applications.

This cement is said to have positive adhesion on such surfaces as glass, rubber, metal, formica and vinyl plastics. It is a thermoplastic resin, with a dry-film softening point of 230 F.

Bench Type Wire Straightener

A motor driven bench model rotary type wire straightener has been placed on the market by *Mettler Machine Tool, Inc., Shuster Wire Machine Div.*, New Haven, Conn.

With its new, integrated motor drive, and small, compact design, this model, it is said, is particularly suited for use in the



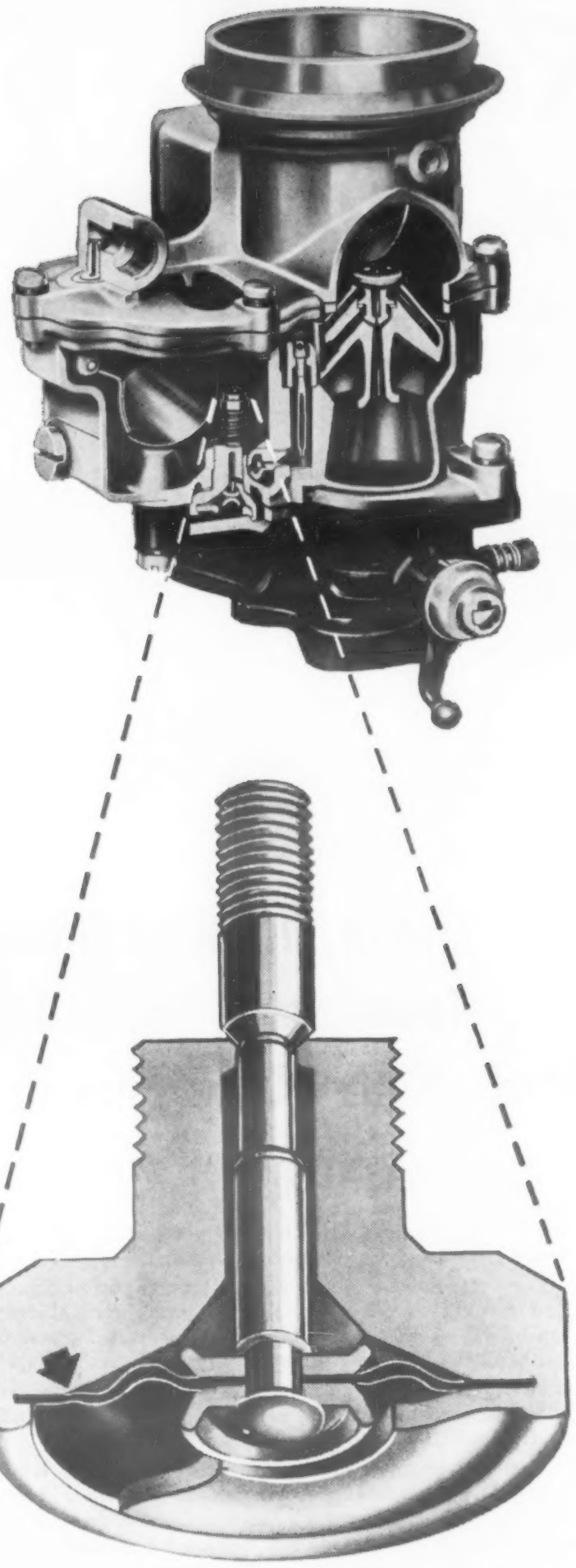
This wire straightener is of particular use in the electrical industry.

electrical field. Machines of this type are available for wire sizes from 1/64 to 3/16 in. in dia.

These machines are built on the standards established for this company's other wire straightening machines.

HOLDS GAS UP...

SHOOTS COST DOWN



Good eleven years ago—good today! In 1938, Holley Carburetor Co. developed the fuel economizer valve you see here. It is operated by suction, from below the throttles, acting on a diaphragm held by spring tension. At low throttle openings, the vacuum draws down the diaphragm, which closes the valve, checks the flow of fuel and produces a more economical mixture.

For the diaphragm in this economizer, Holley needed a material that would flex freely during long periods of engine operation. It had to work efficiently in contact with all types of fuels at temperatures up to 250°F. It had to be reasonable in cost. And it had to have long life. The Holley Co. chose a material that it had been using successfully in carburetor diaphragms since 1935 . . . Du Pont "Fairprene"* coated fabric. And today, "Fairprene" is *still* its first choice!

"Fairprene" is extremely tough, yet is light in weight, and makes a highly sensitive diaphragm. It resists gasoline, oil, grease, kerosene, and aging in air, oxygen or gases. And it stays flexible at both high and low temperatures . . . has low permanent set and drift. "This economizer," says Holley, "could not be produced without a material like 'Fairprene.'"

Hundreds of manufacturers are improving old products . . . and making better new products . . . by using Du Pont "Fairprene" coated fabric. It will pay you to investigate the possibilities of "Fairprene" for your own use. Du Pont Technical Service will gladly work with you in engineering special grades of "Fairprene" to meet your specific needs. For more detailed information, just clip the coupon below.

*"*Fairprene" is Du Pont's trade mark for its line of products made from synthetic elastomers. Available in the form of Coated Fabrics, Sheet Stocks without fabric insert and Adhesives.*

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Please send me the latest Technical Bulletin on "Fairprene" Coated Fabrics, Sheet Stocks and Industrial Adhesives.

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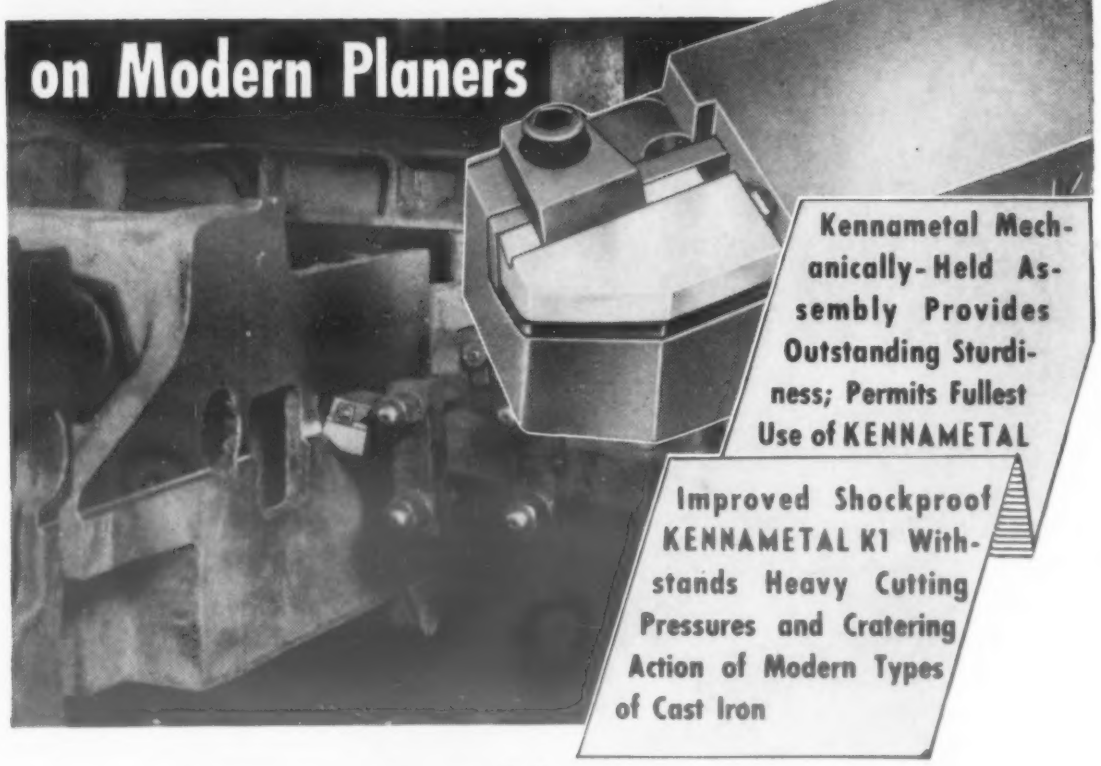
Remove up to 6 cu. ft. of Cast Iron Per Tool Grind

on Modern Planers



Kennametal Mechanically-Held Assembly Provides Outstanding Sturdiness; Permits Fullest Use of KENNAMETAL

Improved Shockproof KENNAMETAL K1 Withstands Heavy Cutting Pressures and Cratering Action of Modern Types of Cast Iron

Strong, Durable, Clamped-on Kennametal Planer Tools . . . Make Heavy-Duty Planing Practicable

Now you can take heavy roughing cuts at high speeds (100-250 ft/min) on any of the newer type planers having a tool lifter. Clamped-on Kennametal Planer Tools make it practicable . . . and *profitable*. They remove metal at a faster rate—keep machine down time to a minimum—reduce tooling cost per piece —minimize grinding time and confusion.

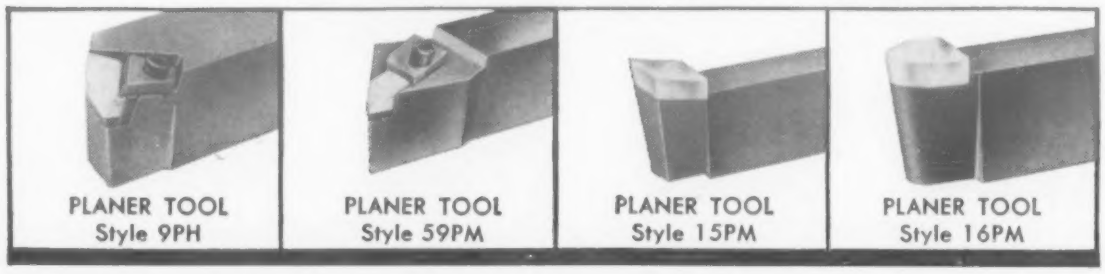
Yes—you need a good, rigid, properly-powered, correctly-adjusted planer. And you *must* have a strong, shock-proof, thermal-strain-free carbide tool that can take a beating and like it. Here's where the uniformly sound structure of mechanically-held Kennametal K1 pays off. Read these typical performance reports:

"Kennametal Planer Tools remove 6.5 cubic feet of semi-steel per tool grind." "5 cubic feet of 180 Brinell cast iron removed per grind." "6 cubic feet of 180 Brinell cast iron removed per grind."

Our field engineers can help you apply this cost-cutting Kennametal tooling to your planing operations. Ask them to do it. And keep in mind—the cemented carbide that has the strength and durability to do tough roughing jobs on planers successfully is the carbide that can cut tooling costs on *all* your milling, boring machine, and lathe work. That's Kennametal.

KENNAMETAL *Inc.*, Latrobe, Pa.®

MANUFACTURERS OF SUPERIOR CEMENTED CARBIDES AND CUTTING TOOLS THAT INCREASE PRODUCTION



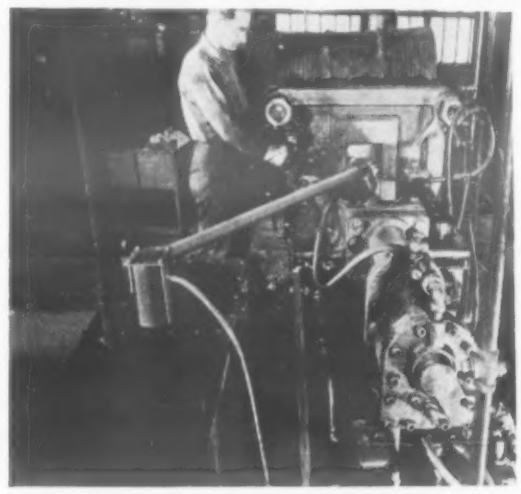
PLANER TOOL Style 9PH | PLANER TOOL Style 59PM | PLANER TOOL Style 15PM | PLANER TOOL Style 16PM

New Materials and Equipment

New Unit Automatically Ladles Aluminum to Die Casting Machine

Automatic ladling, a new development in removing molten aluminum from melting furnace to die casting machine, has been announced by the *Lindberg Engineering Co.*, 2444 W. Hubbard St., Chicago.

Operation of the ladling unit is simple. The discharge side of the furnace is sealed over with a metal plate through which extends a refractory tube. By means of a hollow graphite block and a graphite tube mounted on the furnace cover, the discharge



The new ladling unit in action.

chamber is connected to the injection sleeve just ahead of the piston.

Also extending through the cover is a pressure line connected to a nitrogen tank. This nitrogen line has a pressure control and solenoid valve. By means of a timer synchronized with the die casting machine controls, the valve is opened to admit approximately 1 lb. of pressure to the surface of the molten metal.

By controlling three factors carefully—length of time pressure is applied, the amount of pressure, and the diameter of the graphite pipe—the quantity of molten metal forced into the die casting machine can be accurately controlled.

Cleaning Compound Effective on Aluminum Stampings

A cleaning bath that is effective on aluminum parts that are heavily coated with polishing composition, especially in recessed areas, is being marketed by the *Northwest Chemical Co.*, 9310 Roselawn Ave., Detroit 4.

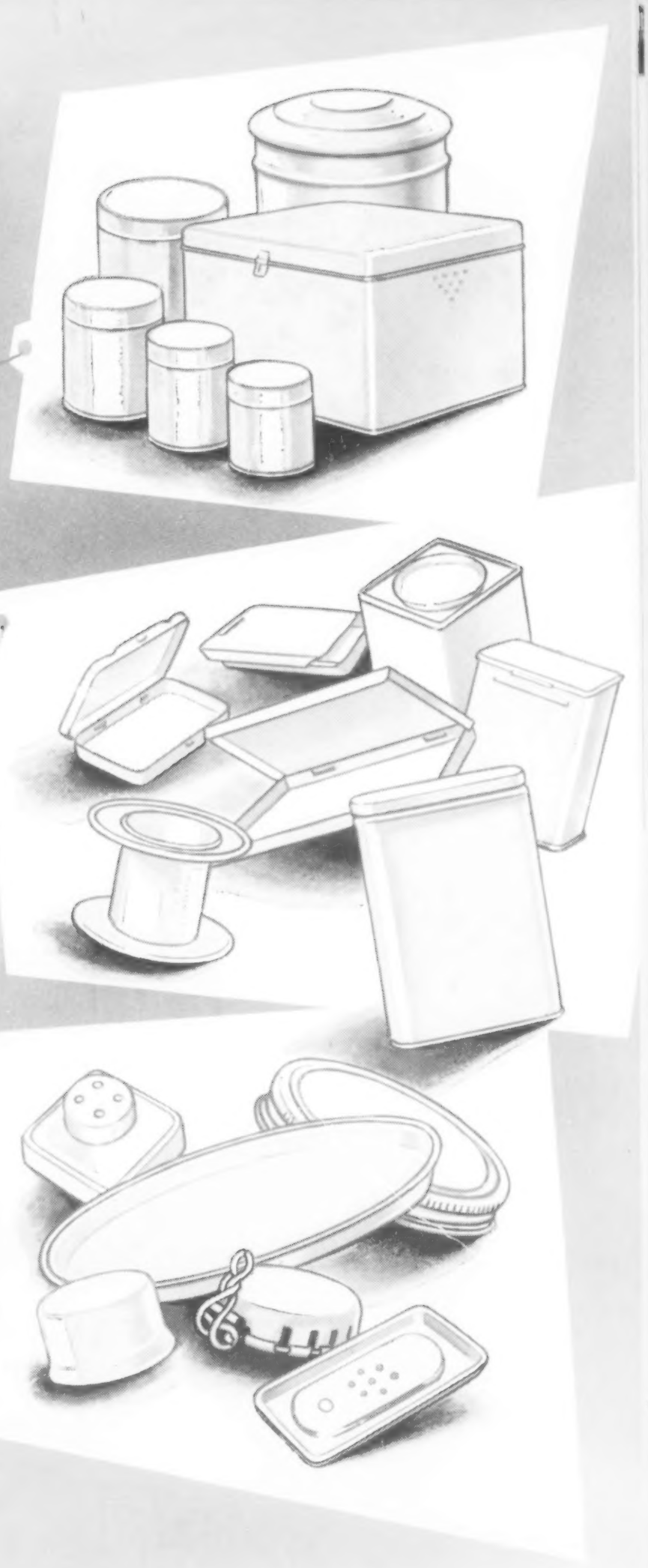
Removal of the soil without scrubbing is accomplished by processing the work

(Continued on page 112)

CANISTERS

CLOSURES

CANS



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Dry-pack containers and closures . . . cans, canisters and caps . . . if you make them of Weirite electrolytic tin plate, you can make them high in quality, low in cost. You'll find you can depend on Weirite for correct ductility, uniform thickness of coating, and accurate gauge. It's obtainable in sheets, and in coils of any desired length in widths up to 33 inches.

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CARBON • GRAPHITE • MOLDED METAL

Engineering News

No. 5

NEW! SEAL RINGS FOR CORROSIVE CHEMICALS

Recent developments in Stackpole carbon-graphite shaft seal rings and washers include types that are highly effective in the pumping of acids and other corrosive chemicals. In addition, Stackpole offers unsurpassed facilities for engineering suitable grades for practically any requirement. Many grades are available and can be produced to suitable tolerances and specifically designed for operation against plates of bronze, brass, aluminum or other materials. Friction is greatly reduced and such unfavorable factors as tamping, packing and tightening are eliminated. Nor is there any danger of shaft abrasion when these composition seals are used!

Practically every application presents a different set of problems. Hence, Stackpole engineers welcome full details of your requirement on which their recommendations and sample seals or washers can be based. You be the judge!

HERE'S SIMPLIFIED ULTRA-CRITICAL RESISTANCE OR VOLTAGE CONTROL

Continuously adjustable rheostats formed of piles of Stackpole carbon and graphite discs provide the ideal means of varying either resistance or voltage with maximum precision and smoothness simply by applying pressure to the piles. Applications range from generating equipment voltage regulators to line, speed and pressure regulators, continuously variable rheostats, pressure indicators and others. Recent Stackpole developments in this field include a special carbon-graphite mix which enables a single pile of only 39 discs to assure the high resistance needed for a sewing machine control previously involving two piles totalling 150 discs.

If you have a possible application, why not submit details to Stackpole for recommendation?

DASH POT PLUNGERS WITHOUT LIQUID LUBRICANTS

Few applications better illustrate the versatility of Stackpole graphite than its use for dash pot plungers—for the simple reason that the static friction of graphite against the smooth metal cylinder is not much greater than that of the sliding friction. No liquid lubricants which would be adversely affected by temperature changes are required. Thus the damping coefficient of a graphite plunger is determined almost entirely by the viscosity of the air itself. Stackpole facilities in this specialized field provide for the design and production of eminently satisfactory plungers for practically any dash pot need.

LOW-FRICTION BEARINGS

OF CARBON AND GRAPHITE

The use of self-lubricating bearings of carbon and graphite composition holds interesting possibilities for a wide variety of modern equipment. Units can be molded rather inexpensively to suitable tolerances and both the composition of the bearing mix and the shape of the finished piece can readily be designed for maximum efficiency. Beyond this, the graphite greatly decreases both friction and wear by coating *both* surfaces. Stackpole has achieved considerable success in this field and would like to tackle additional bearing problems where carbon and graphite compositions may hold the answers.

Why not send full details of your application for recommendation by Stackpole engineers?

GET THIS HELPFUL CARBON-GRAPHITE SPECIALTIES BOOKLET

This 44-page, profusely illustrated book has been prepared to help you evaluate the possibilities of components of molded carbon, graphite and powdered metal composition in a broad range of modern equipment. Included are details on Stackpole tube anodes, battery carbons, ground rods, contacts, carbon piles, chemical carbons, friction segments, clutch rings, brazing and welding carbons, carbon molds and dies and many other products.

STACKPOLE CARBON COMPANY, St. Marys, Pa.

pick and shovel days are over

Bull-dozers and steam shovels ended pick and shovel methods in earth moving. So modern strip mill facilities banished pick and shovel techniques in rolling stainless sheet and strip. Climaxing this progress, CRUCIBLE, a *specialty steel* producer for half a century, has built an $18,000,000 mill at Midland Works *specifically* for rolling stainless steel—the *first mill* that has ever been built to take complete advantage of the *best* in stainless rolling practice.

You would expect this of CRUCIBLE. You would expect that the top organization in the *specialty product* field would make stainless as a specialty—and you would be right. Here at Midland, hot and cold rolled stainless sheet and strip are made in widths from ½″ to 50″ inclusive, in all gauges, grades and finishes, with the same precise quality control that has made CRUCIBLE the leader in special service steels for generations.

Moreover, with Trent Tube Co. joining the organization you can now turn to CRUCIBLE for *every* type of stainless—sheets, plates, strip, bars, tubing, forgings, wire and castings. Data sheets are available for all grades. Your inquiries will have prompt attention.

CRUCIBLE STEEL COMPANY OF AMERICA
405 Lexington Ave., New York 17, N.Y.
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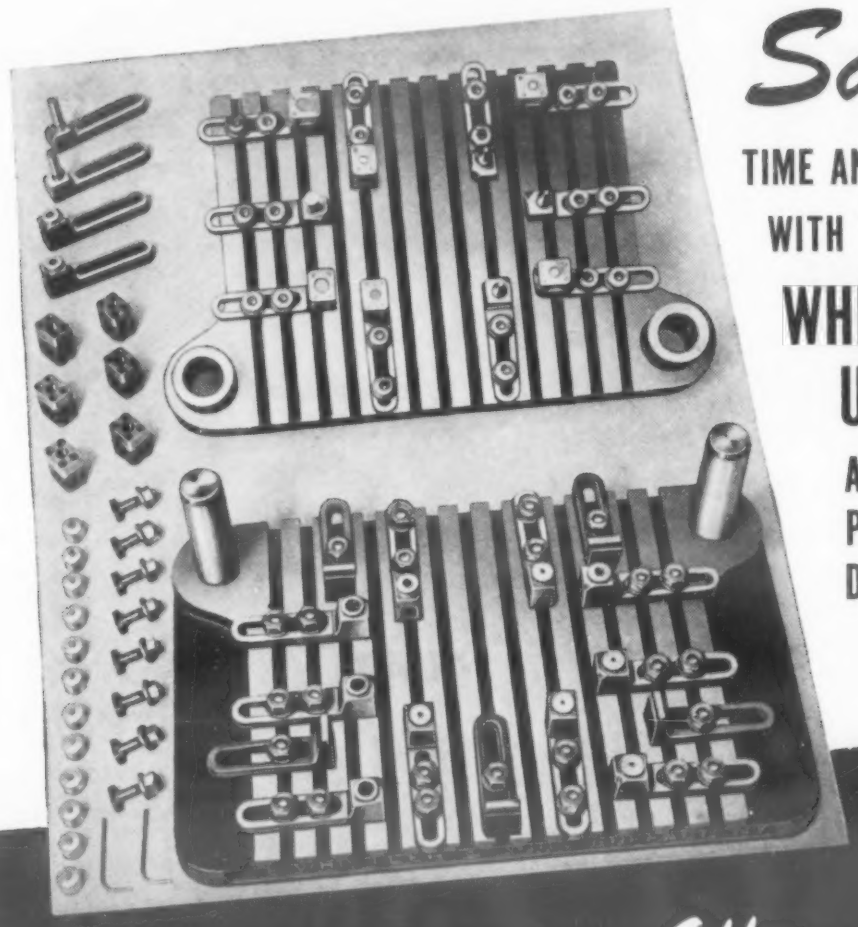
for stainless sheet and strip

CRUCIBLE first name in special purpose steels

hot and cold rolled STAINLESS SHEET AND STRIP

STAINLESS • HIGH SPEED • TOOL • ALLOY • MACHINERY • SPECIAL PURPOSE • STEELS



Save

TIME AND MONEY WITH THIS NEW

WHISTLER U-375

Adjustable Perforating Die Set

Special Introductory Offer

To prove the advantages of Whistler Adjustable Dies under your production conditions, we are offering these U-375 units at a special low price.

1 DS-1012-1 (10″ x 12″) T Slotted Die Set
12 DR-375 Die Retainers
12 PR-375 Punch Retainers
12 PU-375 Round Punches
12 DBU-375 Die Bushings
12 S-375 Strippers
12 LLP-375 Locating Pilots
4 GA-375 Standard Gauges
1 SUP-375 Set-Up Plug

Punches and dies are your own selection of sizes from 1/32″ up to 3/8″ diameters. Everything needed to start production is included.

Shipped complete upon receipt of your order for only . . . . . $280 Net F.O.B. Buffalo, N. Y.

A MONEY-SAVING opportunity to prove in your own plant the many advantages of Whistler Adjustable Dies. Now being employed by thousands of metal working shops. The compact design of this special U-375 unit (10″ x 12″ working surface) provides up to 25 holes, 1/32″ to 3/8″ diameter. Pierce materials up to and including 1/16″ mild sheet steel . . . in one operation. Minimum centers of 7/8″ are permitted. Set-ups are made quickly and into production within hours. Precision perforating on long or short runs at much reduced expense. Re-use of punches and dies writes off first cost. The U-375 unit is shipped complete ready for immediate set-up.

SENT FREE ON REQUEST

Special U-375 Booklet and General Catalogs

In brief informative style, with clear-cut illustrations, this literature gives complete details about Whistler Adjustable Dies. Write.

S. B. WHISTLER & SONS, INC.

756 MILITARY ROAD • BUFFALO 17, NEW YORK

New Materials and Equipment

through this bath composed of from 2 to 4 oz. per gal. of Alkalume No. 1 plus 2% by volume of Liquid Stripper No. 2 for a period of from 2 to 5 min. at 160 to 190 F, temperature depending upon the transfer time; this is followed by a thorough rinse of the free flowing or spray type. This bath is preliminary to the conventional painting, anodizing or plating cycle. It can be used in manual or automatic equipment where cleaning is by immersion.

Melting Pot Has Aluminum Dip Compartment

A new dip tank or melting pot that is thermostatically controlled and that has aluminum casting dip-compartment has been introduced by the *H. McNaughton Co.*, 201 Parsons St., Kalamazoo, Mich. It is useful for dipping ethylcellulose and other removable plastic coatings on parts, tools and dies. As an oil bath it is used to transfer heat at accurately controlled temperature to irregular shaped devices and containers.

Large top opening and sloping walls with smooth rounded corners permit all parts of interior and bottom to be easily reached for dipping operations or cleaning out. Any temperature set on the calibrated dial is held within 1 F. Casting has a large ledge to catch overflow, which also makes it spill-over proof.

Closed type heating elements of 1000

The tank shown here is well insulated and is fast heating.

w. and thermostat range 60 to 250 F or 200 to 500 F are installed for either 115 or 230 v., as specified.

Overall size is 12 by 12 by 10 in. high. Thick walled aluminum casting dip compartment is tapered from 7 by 7 in. at top to 5 by 5 in. at bottom by 6 in. deep.

ALUMINUM TAKES ALL FINISHES

All mechanical finishes, for example

For the final finish or to give texture to other finishes, you'll have no trouble applying mechanical finishes on aluminum. Buffed, scratchbrushed, sandblasted, tumbled, hammered . . . aluminum takes them all.

Alcoa Aluminum takes finishes you use on other metals. But only aluminum takes the patented Alumilite and Alrok finishes that seal color *in* the metal surface and add resistance to wear and corrosion.

Alcoa's Laboratories have been developing finishes for aluminum for half a century. Bring your finishing questions to the company that knows aluminum best Ask your nearby Alcoa Sales Office for a copy of the book, "Finishes for Alcoa Aluminum". Or write ALUMINUM COMPANY OF AMERICA, 662-H Gulf Building, Pittsburgh 19, Penna.

ALCOA FIRST IN **ALUMINUM**

ALCOA ALUMINUM

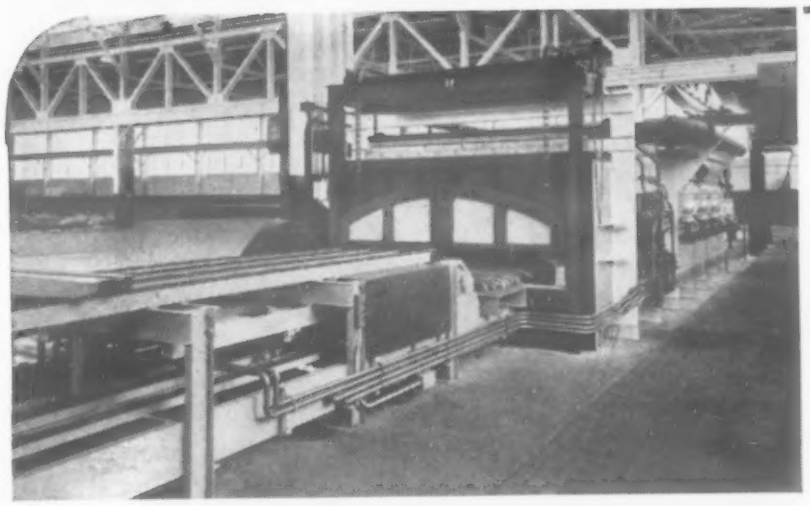
INGOT · SHEET & PLATE · SHAPES, ROLLED & EXTRUDED · WIRE · ROD · BAR · TUBING · PIPE · SAND, DIE & PERMANENT MOLD CASTINGS · FORGINGS · IMPACT EXTRUSIONS
ELECTRICAL CONDUCTORS · SCREW MACHINE PRODUCTS · FABRICATED PRODUCTS · FASTENERS · FOIL · ALUMINUM PIGMENTS · MAGNESIUM PRODUCTS

SHOW US A JOB THIS EMULSION TYPE CLEANER CAN'T HANDLE!

It's Houghto-Clean 220, a Houghton development for cleaning metal parts, either in tanks or power washers. You'll find it economical and efficient for almost every cleaning need—except where a chemically clean surface is required; in such cases use Houghto-Clean alkaline cleaners. Houghto-Clean 220 has a high flash point, is not toxic, leaves a very slight film which aids in preventing rust. For prices and data, write

E. F. HOUGHTON & CO.
303 W. Lehigh Ave., Philadelphia 33, Pa.

HOUGHTO-CLEAN 220



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SPECIAL ATMOSPHERE TREATMENTS

A SIZE AND TYPE OF FURNACE FOR EVERY PROCESS PRODUCT OR PRODUCTION

EF CONTINUOUS PUSHER FURNACE
HEATS 12,000 LBS. COPPER BARS PER HOUR

● Copper wire bars up to 6 x 6 x 66 inches are uniformly and scale-free heated for rolling in the EF gas-fired, continuous pusher type furnace pictured above. It has capacity to heat 12,000 pounds of bars per hour to 1650°F.

For dependable, low cost, uniform heating and heat treating results, investigate EF furnaces and developments. Available in gas-fired, oil-fired, and electrically heated designs. Sizes and types to meet any requirement. No problem is too big – too small – or too complex. Let us work with *you* on *your* requirements!

EF

THE ELECTRIC FURNACE CO.
GAS FIRED, OIL FIRED AND ELECTRIC FURNACES
Salem - Ohio

News of...

ENGINEERS COMPANIES SOCIETIES

Engineers

The Lukens Steel Co. has augmented its Development Engineering personnel with three additions to its staff. They are *Robert Ervin,* an engineer formerly employed by the Union Bag & Paper Corp.; *Max Unseld,* a design engineer at Bagley & Sewall; and *A. Reed Schuster,* an erection supervisor, also from Bagley & Sewall. Another announcement from Lukens is the retirement of *Darwin S. Wolcott,* vice president, after 24 years of service.

Harry R. Reynolds has been promoted to the position of consulting engineer of the Fafnir Bearing Co. *Howell L. Potter,* formerly assistant chief engineer, succeeds Mr. Reynolds as chief engineer.

The recent election of officers of the Bound Brook Oil-Less Bearing Co. included the following: *W. F. Jennings,* president and treasurer; *H. O. Johnson,* executive vice president and secretary; *George O. Smalley,* vice president; *W. R. Toeplitz,* vice president in charge of engineering research; *W. T. Allen,* assistant secretary; and *G. R. Brokaw,* assistant treasurer.

Francis W. Davis, consulting engineer, has announced the appointment of *Edmund B. Neil* as his Midwest associate.

The appointment of *Warren S. Master,* formerly rectifier engineer, to the position of chief engineer of the Richardson-Allen Corp. has been announced.

H. L. Smalley has been promoted to assistant to the president of the Harbison-Walker Refractories Co. Mr. Smalley, previously assistant to the vice president, will make his headquarters in Pittsburgh.

The Carborundum Co. recently elected General *Brehon Somervell* a member of its board of directors. General Somervell is president of Koppers Co., Inc.

The appointment of *Harry H. Lumley* as assistant to the vice president of the American Steel & Wire Co. has been announced. *John R. Gaut,* previously assistant manager of operations, succeeds Mr. Lumley as Chicago district manager of operations of this U. S. Steel subsidiary. Mr. Lumley will continue to maintain his headquarters in Chicago.

Sylvania Electric Products, Inc. has promoted *Ross Gessford,* engineering specialist in cathode ray tubes, to the position of chief engineer of its Television Picture Tube Div.

Frank K. Metzger, manager of railroad sales of the Midvale Co., was recently pro-

IT STILL TAKES ACORNS . . .

TO PRODUCE MORE MIGHTY OAKS OF AMERICAN INDUSTRY

In the past 45 years Doehler-Jarvis has grown from acorn size to the largest company in the die casting industry.

We know from experience all the difficulties on the road to the top. And we fully realize that this process of industrial growth, from acorn to oak, must continue if we and all enterprise are to prosper.

Therefore, we at Doehler-Jarvis are constantly on the lookout for little "acorn" companies which need help to grow. We can be of great assistance to them with our die casting process to eliminate heavy investments and, at the same time, reduce costs by converting from more complex and expensive methods.

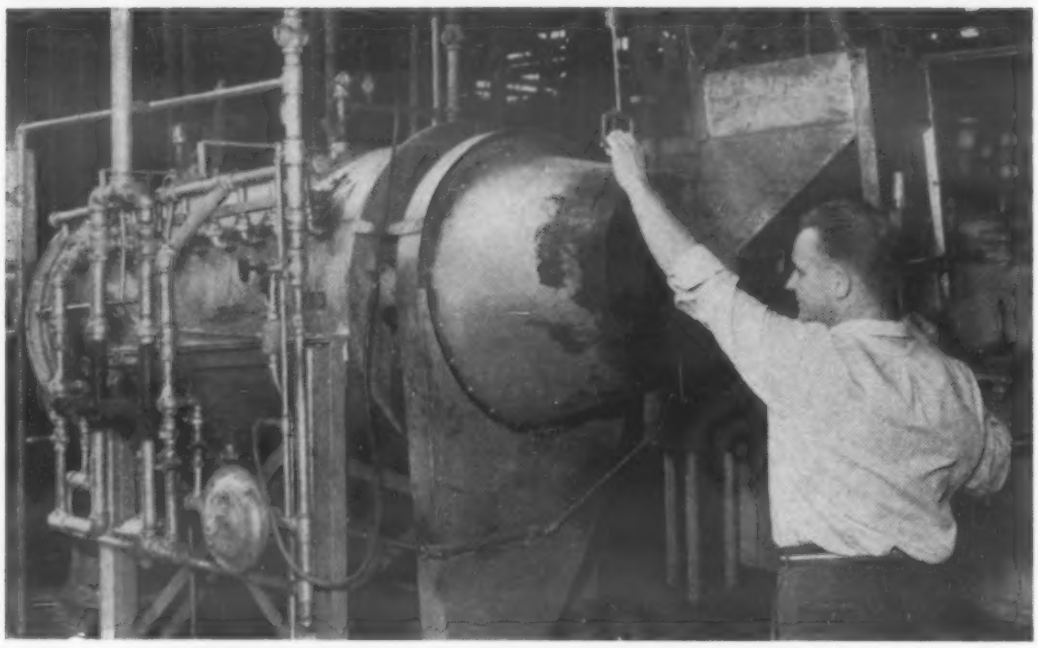
Having already helped many of our smaller customers prosper and grow, we are anxious to help others the same way.

No matter how small your operations, our engineers, technicians and experienced business executives will be glad to discuss your production problems with you.

DOEHLER-JARVIS CORPORATION

The World's Largest Producer and Finisher of Die Castings

Executive Office: **386 FOURTH AVENUE · NEW YORK 16, N. Y.**



CONTINUOUS ROTARY HEAT TREATING FURNACES

For clean hardening, annealing, normalizing, carburizing, Ni-Carbing, etc., of many small parts.

The self-metering feed hopper arrangement permits the operator to pre-load a one-half hour charge of work which is then continuously and uniformly processed without further attention, thereby eliminating costly man-hours. If desired, a continuous feeding mechanism may be employed which completely eliminates the need for an operator.

Write for Bulletin 801-4 today.

AMERICAN GAS FURNACE CO.

142 SPRING STREET · ELIZABETH, N. J.

INDUCTION HEAT

PERMITS 2 OZ. TOLERANCE

ON HIGH SPEED FORGING PRESS

It previously took 8 to 10 drops of a hammer, with slow flow of metal, to achieve close tolerances required for connecting rod forgings. But this leading automobile plant recently combined scale-free, closely controlled Ajax-Northrup heat with improved die design, and pioneered the development of rods *press-forged* at unheard-of production rates.

Clean, fast induction heat now saves tons of steel yearly in many forge shops. Increases die life as much as 20%. No abrasive scale, and accurate timing prevents overheated dies. A bank of Ajax-Northrup heaters at each machine handles several sizes of stock, heating variable lengths with quickly adjustable timing and feeding devices so that jobs can be changed in a jiffy. Saves start-up time; the first hot billet is ready in seconds. No need to "pull" stock during shut-downs—just push the "off" button instead. Working conditions are better, too.

Whether you want to improve quality or reduce costs, you'll find the right answer in Ajax-Northrup. Over 33 years experience in successful induction heating and melting.

AJAX ELECTROTHERMIC CORPORATION

AJAX PARK, TRENTON 5, N. J.

Associate Companies

THE AJAX METAL COMPANY • AJAX ELECTRIC FURNACE CORPORATION
AJAX ELECTRIC COMPANY, INC. • AJAX ENGINEERING CORPORATION

SINCE 1916

AJAX NORTHRUP
HEATING & MELTING

1195

News of...

ENGINEERS COMPANIES SOCIETIES

moted to the position of general sales manager of the company.

The Electronic Engineering Corp., for the past year known as Industrial Development Labs, elected as its president *P. J. Cudone,* president of the Cudmore Supply Corp.

Several appointments at the General Electric Co. occurred recently. *John W. Belanger* was named assistant general manager of G.E.'s Apparatus Dept. *Glenn B. Warren* succeeds Mr. Belanger as manager of the Turbine Divs. *Edwin E. Parker* assumed Mr. Warren's position of manager of engineering of the Turbine Divs. Another new assistant general manger of the Apparatus Dept. is *Nicholas M. DuChemin,* formerly manager of the Apparatus Dept.'s Meter & Instrument Divs. His successor is *Harold E. Strang,* previously engineering manager of the Affiliated Manufacturing Companies Dept. of G.E. In the Locomotive & Car Equipment Divs., three changes were made. *H. O. Trumpfheller,* formerly assistant to the manager of manufacturing, was named manager of manufacturing; *David Blair,* production manager, became assistant to the manager in charge of procedures; and *C. E. Shank,* assistant production manager, is now production manager.

A recent meeting at Oakite Products, Inc. resulted in the election of *D. C. Ball,* founder and long time president of the company, as chairman of the board. *John A. Carter,* formerly general manager, succeeded Mr. Ball as president.

The retirement of *Clarence W. Daniels,* plants engineer and a director of the Norton Co., after 36 years of service has been announced. Mr. Daniels will continue to serve the company, however, as a member of the board of directors. *Allan F. Hardy, Jr.* assumes Mr. Daniels' position of plants engineer.

The Firth Sterling Steel & Carbide Corp. recently elected *Kenneth D. Mann* chairman of the board. Mr. Mann previously served as manufacturing vice president of the Reynolds Metals Co. Another promotion was that of *A. E. Barker* to assistant to the president. Succeeding Mr. Barker as the New York sales manager is *Howard M. Dawson,* formerly president of the Jessop Steel International Co.

Curtis C. Gary was appointed assistant to the president of the Brake Shoe & Castings Div. of the American Brake Shoe Co. He will continue to be located at the headquarters in New York City. Another promotion by American Brake Shoe is that of *Roger W. Batchelder* to the vice presidency in charge of sales of the National Bearing Div. His headquarters will continue to be in St. Louis.

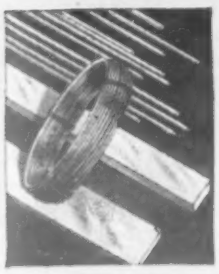
The appointment of *Charles Pingry* as district sales engineer of the Dallas office has been announced by the Chain Belt Co. of Milwaukee.

REYNOLDS ALUMINUM

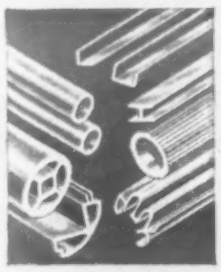
FAST SERVICE FROM DISTRIBUTOR WAREHOUSE STOCKS

Aluminum in less-than-carload lots is available with speed and with many helpful services from the qualified metal distributors listed below. Reynolds technicians, in offices across the country, work closely with these distributors on special problems. Together they can bring all the advantages of Reynolds *Lifetime* Aluminum to your products and production, just as they are helping metal fabricators everywhere in their conversion to this modern, lightweight metal.

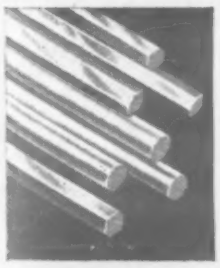
Consider aluminum . . . consult your Reynolds Distributor.



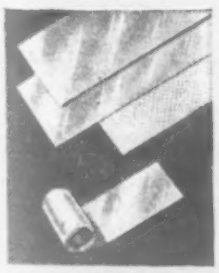
Wire, Rod and Bar



Extrusions Structurals



Screw Machine Stock



Coil, Sheet, Plate Plain & Embossed

REYNOLDS DISTRIBUTORS HAVE ALUMINUM MILL PRODUCTS FOR IMMEDIATE DELIVERY FROM WAREHOUSE STOCKS

ALABAMA
Arnold-Brown Metals & Supply Co., Birmingham 5

CALIFORNIA
American Brass & Copper Co., Oakland 7 (Wire, rod, bar, structurals only)
Richard G. Stern & Company, Los Angeles 46
Tay-Holbrook, Inc., San Francisco 1
United States Steel Supply Co., Los Angeles 54 and San Francisco 1
Western Metal Supply Company, San Diego 12

COLORADO
Marsh Steel Corporation, Colorado Springs and Denver 5

FLORIDA
Horne-Wilson, Inc., Jacksonville 6, Orlando, Miami 36 and Tampa 1

IDAHO
Idaho Steel Products, Inc., Boise

ILLINOIS
United States Steel Supply Co., Chicago 4
Benjamin Wolff & Company, Chicago 36

INDIANA
Brass & Copper Sales Co., Indianapolis, 4

LOUISIANA
Stauffer, Eshleman & Co., Ltd., New Orleans 1

MARYLAND
Clendenin Bros., Inc., Baltimore 2 (Wire, rod, bar, structurals only)
Lyon, Conklin & Co., Inc., Baltimore 30

MASSACHUSETTS
Bay State Refining Company, Chicopee Falls (Ingots only)
Arthur C. Harvey Company, Boston 34
Pratt & Inman, Worchester 8 (Wire, rod, bar, structurals only)

MICHIGAN
Kasle Steel Corporation, Detroit 9

MINNESOTA
Newell T. Miner Company, St. Paul 4

MISSOURI
Brass & Copper Sales Co., Kansas City 6 and St. Louis 3
Marsh Steel Corporation, N. Kansas City

NEW JERSEY
Edgcomb Steel Corporation, Hillside

NEW YORK
Beals, McCarthy & Rogers, Inc., Buffalo 5

OHIO
Hamilton Steel Company, Cleveland 8
Summer & Company, Columbus 8

OREGON
American Steel Warehouse Co., Portland 14

PENNSYLVANIA
Levinson Steel Sales Company, Pittsburgh 19
Potts-Farrington Company, Phildelphia 7

TEXAS
Marsh Steel Corporation, Dallas 10
Moncrief-Lenoir Manufacturing Co., Dallas 1 and Houston 1

UTAH
Salt Lake Hardware Company, Salt Lake City 9

WASHINGTON
Seattle Steel Company, Seattle 4

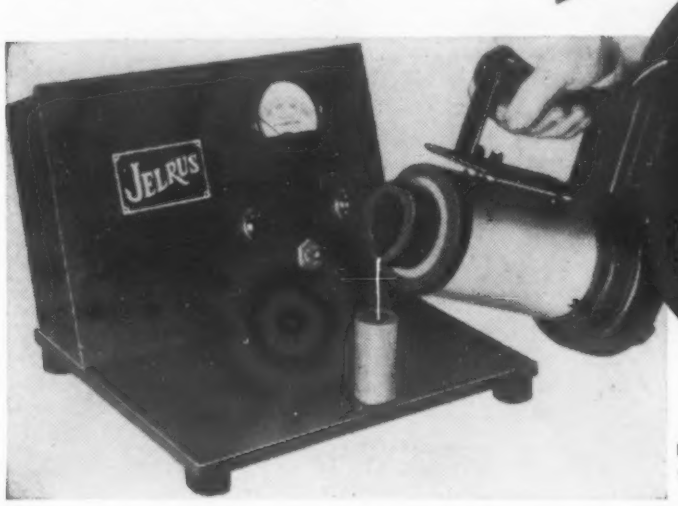
REYNOLDS METALS

DISTRIBUTORS of REYNOLDS ALUMINUM

REYNOLDS METALS COMPANY • LOUISVILLE 1, KENTUCKY

OFFICES IN PRINCIPAL CITIES • LISTED UNDER "ALUMINUM" IN YOUR CLASSIFIED PHONE BOOK

VERSATILE! COMPACT! ACCURATE! FAST! ECONOMICAL!



NEW
JELRUS
'Handy-Melt'
PORTABLE
ELECTRIC MELTING FURNACE

Handy-Melt PRICE—complete $142.00*
Crucibles $2.50*; Extra Muffle $12.50*
*F.O.B. New York City

For melting, alloying, casting, metallurgical investigation, and many other uses, the new portable Jelrus Electric Melting Furnace really does a *better* job! It's a self-contained plug-in unit (operating on 110 V. AC or DC), light in weight (5 pounds) and really *compact* (12″x10″x9″ high).
Furnace capacity permits melts up to 600 dwt. of gold—2 lbs. Avoir. of brass or equivalent—with a simple flick of the switch. Temperature indicator assures consistent results on successive melts. Designed with features that prevent overheating of metal and eliminate metal oxidation, this portable furnace gives maximum service for a modest investment.

Send for Data Sheet Today!

I.SHOR 64 W. 48th ST. • NEW YORK 19 • DEPT. M

precision casting sales and engineering

HOW THE WROUGHT BRASS INDUSTRY CONSERVES METAL

No industry melting *commensurate tonnage** of vital metal can quite match the brass mills for conservation and low melting losses. The savings of metal total millions of pounds; clearly the method they use is worth noting:

Virtually all the brass mills in North America use the Ajax-Wyatt induction melting furnace, for it has the lowest metal losses in the field — less than 1% — with superior temperature control and unapproached economy of operation on high production schedules such as we have today.

The accepted melting tool in brass rolling mills throughout the world.

* *Upwards of 3 billion pounds annually*

AJAX ELECTRIC FURNACE CORP.
1108 Frankford Avenue • Philadelphia 25, Pa.

THE AJAX WYATT INDUCTION MELTING FURNACE

ASSOCIATE COMPANIES:
AJAX METAL COMPANY, *Non-Ferrous Ingot Metals and Alloys for Foundry Use*
AJAX ELECTROTHERMIC CORPORATION, *Ajax-Northrup High Frequency Induction Furnaces*
AJAX ELECTRIC COMPANY, INC., *The Ajax-Hultgren Electric Salt Bath Furnace*
AJAX ENGINEERING CORPORATION, *Ajax-Tama-Wyatt Aluminum Melting Induction Furnaces*

News of...

ENGINEERS COMPANIES SOCIETIES

Harley A. Gardner was named treasurer of the Willard Storage Battery Co., replacing *I. K. Schnaitter,* who resigned as treasurer and assistant secretary. *C. H. Bell* assumes the position of assistant secretary, and *J. C. Crum* is assistant treasurer, succeeding Mr. Gardner.

The Armour Research Foundation of the Illinois Institute of Technology has appointed *Virgil H. Disney* a supervisor of electronics. Mr. Disney, formerly assistant section head in research at the airplane division of the Curtiss-Wright Corp., will be in charge of the second electronics section, with *James L. Murphy* continuing as supervisor of the first group.

J. Tedford Bachman has resigned as assistant vice president of operations of the Sharon Steel Co. to become general manager of sales of the Cold Metal Products Co.

Mack Trucks, Inc. has announced that *L. G. Bissel* and *C. T. Ruhf* have relinquished their respective positions as chairman of the board and president. *E. D. Bransome,* a director of the company and president of the Vanadium Corp. of America, was elected to both offices. Mr. Bransome will continue his association with Vanadium as chairman of the board and member of the Executive Committee. Both Messrs. Bissel and Ruhf will continue as members of the Mack board, with Mr. Ruhf remaining with the company in a consulting capacity.

J. D. Greensward was named general manager of the Norwood, Ohio works of the Allis-Chalmers Manufacturing Co. Succeeding Mr. Greensward as assistant to the executive vice president of the company's general machinery division is *Robert S. Flesheim,* manager of Allis-Chalmers' electrical department. *Roy M. Casper,* manager of the motor and generator section, assumes Mr. Flesheim's former position.

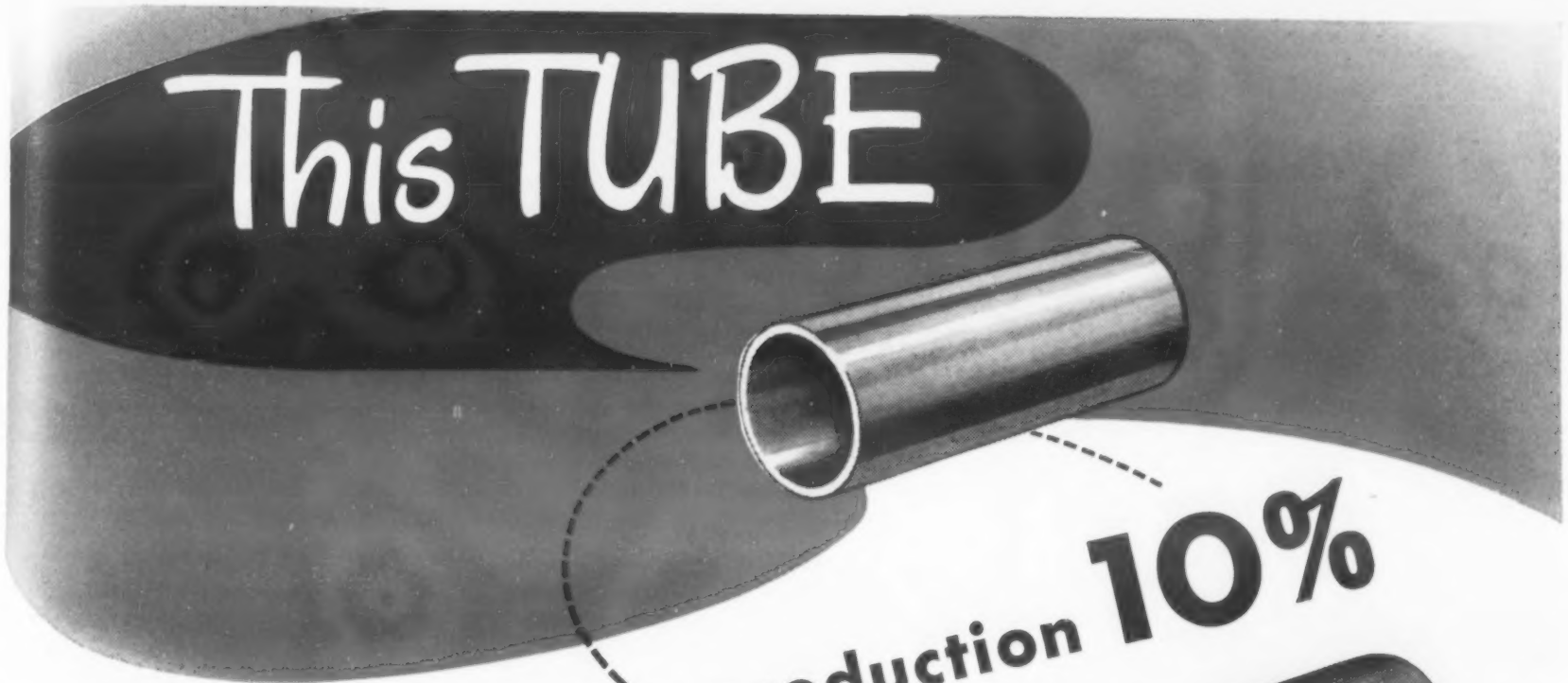
The A. M. Byers Co. has announced the death of *J. Frederick Byers, Sr.,* chairman of the board. Mr. Byers was the son of the late A. M. Byers, who founded the Byers company in 1864.

The sudden death of *John P. Hilands,* general manager-sales for the Tube Reducing Corp., has been announced. Mr. Hilands had been associated with the Tube Reducing Corp. for 14 years.

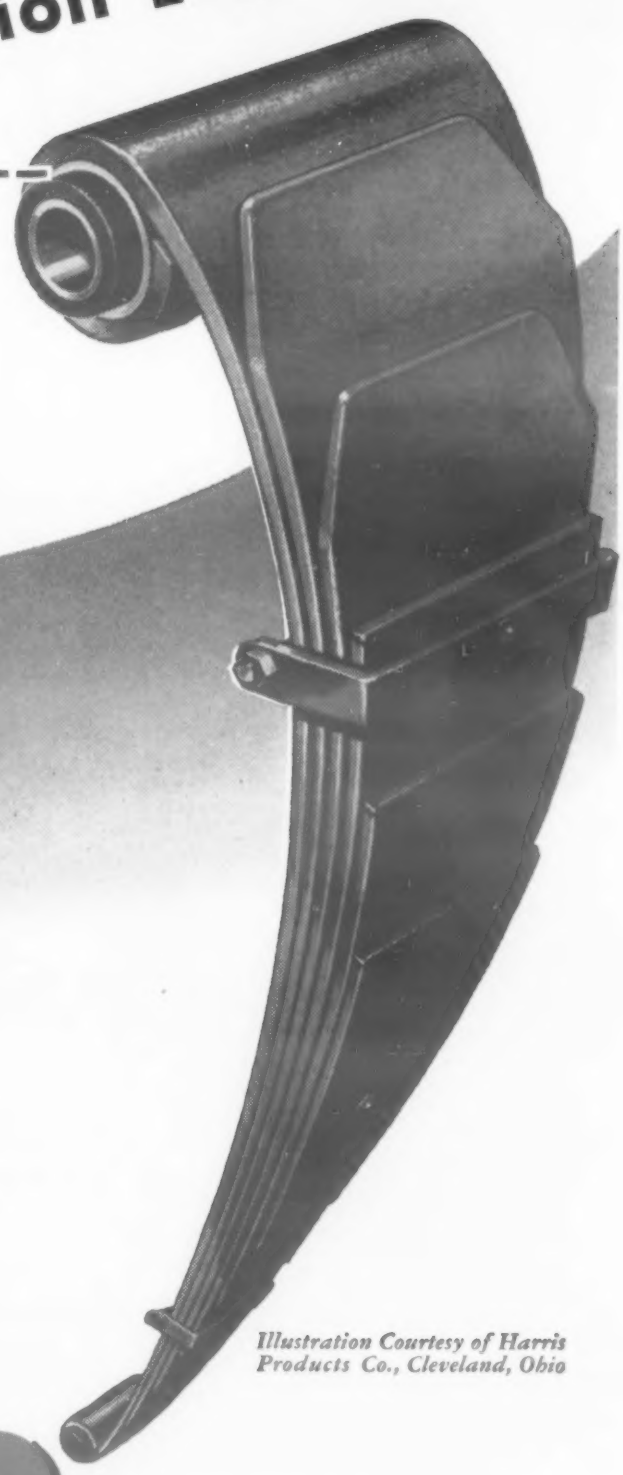
Companies

The *Sturgis Products Co.,* Sturgis, Mich., has changed it corporate name to the *Roto-Finish Co.* Organization and company structure remain the same, except that all sales

This TUBE



boosted bushing production 10%



Just a simple length of straight tubing . . . yet, because it's Republic ELECTRUNITE Tubing, a manufacturer was able to increase production of Silentbloc spring bushings by more than 500 Units per day.

Previously, difficulty was encountered in assembly of rubber inserts inside an ordinary tube. Suggestions made by Steel and Tubes' experienced engineering staff resulted in tubing supplied with a uniformly high finish . . . now the rubber is inserted with minimum rejects . . . saving labor, time, equipment and materials.

An unusual case? Not at all, when you consider the number of other manufacturers who have profited similarly from the adoption of ELECTRUNITE for all tubing applications. From experience, these manufacturers know that ELECTRUNITE Tubing is *uniformly round, uniformly ductile and uniformly sound* . . . throughout every length and every shipment. They know, too, that ELECTRUNITE Tubing can be processed, or fabricated if desired, to meet the specific needs of any application, *before* it leaves the Republic mill.

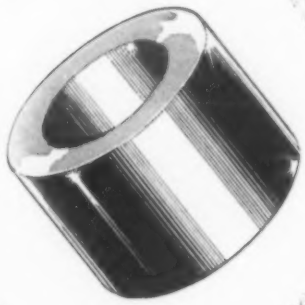
Like more information about this modern electrically-welded tubing? Write, wire or phone *today*.

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, New York

Illustration Courtesy of Harris Products Co., Cleveland, Ohio

Republic
REPUBLIC STEEL
REG U S PAT OFF
ELECTRUNITE TUBING

WORKS WHERE OTHERS WON'T



accurately formed

GRAPHALLOY OILLESS BEARINGS

SPECIFY GRAPHALLOY TRADE MARK REG. U. S. PAT. OFF. WITH CONFIDENCE

SELF-LUBRICATING ● EXTREMELY DURABLE ● CONSTANT CO-EFFICIENT OF FRICTION ● OPERATES DRY — OR *SUBMERGED IN WATER, GASOLINE OR CORROSIVE LIQUIDS* ● APPLICABLE OVER A WIDE TEMPERATURE RANGE — *even where oil solidifies or carbonizes* ● EXCELLENT AS A CURRENT-CARRYING BEARING.

GRAPHITE METALLIZING CORPORATION

1010 NEPPERHAN AVENUE, YONKERS 3, NEW YORK

News of...

ENGINEERS COMPANIES SOCIETIES

and manufacturing has been moved to a new plant in Kalamazoo, Mich.

A new *Chemical Div.* has been established by the *Reynolds Metals Co.* to handle its line of specialties used by the chemical industry. I. P. Macauley, vice president, will head the new division, with headquarters at 19 E. 47th St., New York City.

A Canadian subsidiary to manufacture fluorescent lamps and other lighting equipment has been formed by *Sylvania Electric Products, Inc.* To be known as *Sylvania Electric (Canada), Ltd.,* the company will be located in Drummondville, Quebec. Officers of the new company are: president, F. J. Healy; vice president, R. H. Bishop; secretary, William O'Keefe; and treasurer, M. F. Balcom. Mr. O'Keefe will manage the plant.

The *Elmes Engineering Div. of American Steel Foundries* has recently moved all of its departments from Chicago to larger quarters at 1150 Tennessee Ave., Cincinnati 29, Ohio.

A new acetylene plant has been established by the *Air Reduction Sales Co.* in Acton, Mass. The plant has a rated capacity of 100,000 cu. ft. of acetylene per day.

The *American Steel & Wire Co.* has built and placed in operation a new mill, designated as the *Stainless Steel Div.*, at its Waukegan, Ill. Works. The mill will process round ½-in. and smaller and certain sizes of flat stainless steel wire.

Completion of arrangements with *Sonith Industries, Inc.,* Indianapolis, Ind., for the manufacture and sale of Meehanite castings has been announced by the *Meehanite Metal Corp.,* New Rochelle, N. Y.

The formation of *Tin Research Institute, Inc.* by the *Tin Research Institute,* London, England, has been announced. Located at 492 W. Sixth Ave., Columbus 1, Ohio, the new company will provide free technical service to consumers of tin in the United States. Robert J. Nekervis was appointed supervisor of metallurgical development, and Robert M. MacIntosh is supervisor of chemical development.

Tinnerman Products, Inc. has moved its Detroit district offices to 14550 Third Ave., Detroit, Mich.

Purchase of the assets, plant and business of the *Conant & Donelson Co.,* Conway, Mass., has been announced by the *Threadwell Tap & Die Co.* Production has been transferred to the Threadwell plant at Greenfield, Mass.

The new general office building of the *United Engineering & Foundry Co.* was formally opened at 948 Duquesne Way, Pittsburgh.

The *Indus Tool & Manufacturing Corp.*

Improve Surface Finishes Increase Tool and Die Life

with PANGBORN HYDRO-FINISH

What is Pangborn Hydro-Finish? It's the new, versatile impact blasting process that uses a fine mesh abrasive suspended in water, yet holds tolerances of the work to .0001 inches.

What Hydro-Finish can do for you Pangborn Hydro-Finish can help you three ways, by improving surface finishes, by removing oxide scale, by lengthening tool and die life through proper maintenance.

Hydro-Finish eliminates many tedious finishing operations, reduces cost and time involved in buffing. It improves fatigue life of metal parts it finishes . . . produces a surface virtually free from directional grinding lines.

PANGBORNITE *The best abrasive for all liquid blasting needs. Available in many mesh sizes.*

Write today for details about the new Pangborn Hydro - Finish Cabinet or Pangbornite. PANGBORN CORPORATION, 1203 Pangborn Blvd., Hagerstown, Md.

Look to Pangborn for all latest developments in Blast Cleaning and Dust Control Equipment

Pangborn

BLAST CLEANS CHEAPER with the right equipment for every job

	Machinability	Hobability	Core Strength	Wear Resistance	Distortion in Hardening	Pressure and Temperature
DURAMOLD C water-hardening, hobbing	POOR	BEST	POOR	GOOD	FAIR	LOW to MEDIUM
DURAMOLD B oil-hardening, hobbing	POOR	BEST	FAIR	GOOD	GOOD	LOW to MEDIUM
DURAMOLD A air-hardening, hobbing	*POOR	†GOOD	GOOD	GOOD	BEST	MEDIUM to HIGH
MULTIMOLD for machined molds, heat-treated or carburized	BEST	FAIR	FAIR	**FAIR	FAIR	MEDIUM
BTR oil-hardening, for machined molds	GOOD	FAIR	GOOD	GOOD	GOOD	HIGH
A-H5 air-hardening, for machined molds	FAIR	POOR	BEST	GOOD	BEST	HIGH

* Best, when annealed for machining
† Fair, when annealed for machining
** Good, when carburized and hardened

START WITH THE RIGHT MOLD STEEL

In selecting tool steel for plastic molds the first step is to answer these questions:

1. Is the mold to be cold-hobbed or machined?
2. Is high wear-resistance important? Short or long runs?
3. What core-strength is required?
4. How much distortion in heat-treatment is permissible?
5. High or low operating temperatures? How much pressure?

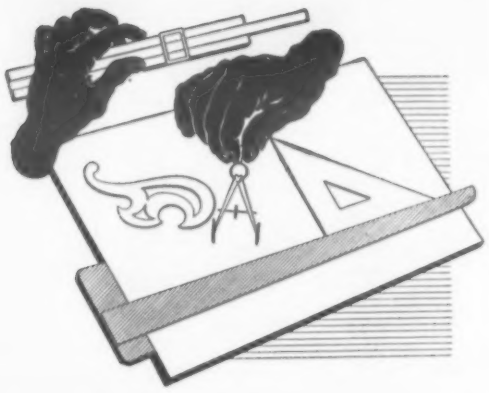
As a further aid in making the best choice, refer to the chart above. This is a general guide to six of our popular mold steels. Each is scrupulously inspected to assure the sound, clean surface and properly-annealed structure necessary for highly-polished cavities.

A Bethlehem metallurgist is ready to assist you with the selection of tool steel . . . or to recommend its proper heat-treatment. Plan now to get full details on Bethlehem Tool Steels. There's a Bethlehem sales office or tool-steel distributor near you. Or write us at Bethlehem, Pa.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by
Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM TOOL STEEL



Design + Metallurgy = SATISFACTION

For specifying a steel machinery part, the designer and the metallurgist make a fine team.

If the part is properly designed (and this means taking the metallurgical treatment into account) the choice of a steel and its proper treatment become relatively simple.

So important are these aspects of good and poor design of parts in relation to the choice of steel and its treatment—the work of the designer and the metallurgist—that we have compiled a 70-page book on this subject, giving many sketches as examples. "THREE KEYS TO SATISFACTION" is interesting and helpful to designers and metallurgists; it is free on request.

Climax Molybdenum Company

500 Fifth Avenue
New York City

Please send your
FREE BOOKLET
3 KEYS TO SATISFACTION

Name.....
Position.....
Company.....
Address.....

MOLY

MM8 F-19

News of...

ENGINEERS COMPANIES SOCIETIES

has changed its name to the *Indus Corp.* The general offices will be located at 431 N. Holmes Ave., Indianapolis, Ind. The company also just opened an assembly plant at Greencastle, Ind.

A modern centrifugal cast iron pipe plant has just been erected by the *Pacific States Cast Iron Pipe Co.* at Provo, Utah.

Commercial operations have begun this summer at a new electrode plant constructed by the *Great Lakes Carbon Corp.* at Morgantown, N. Car.

The *McKay Co.* has moved its Electrode Sales Dept. from York, Pa. to the company's executive offices at 1005 Liberty Ave., Pittsburgh, Pa.

The addition of a Metal Spraying Shop to its facilities at the Jersey City, N. J. plant has been announced by *L. O. Koven & Brother, Inc.*

The first operating phase of the *Pennsylvania Salt Manufacturing Co.'s* new fluorine chemical plant, located at Calvert City, Ky., has begun. Plans for future expansion will make this plant the largest in the Pennsalt chain.

An Injection Custom Molded Div. has been created at the *Bolta Co.*, Lawrence, Mass.

Manufacturers whose products require plastic components now have an opportunity to see and test sample parts before placing final orders. This service is available from the *Ace Plastic Co.*, Jamaica, N. Y.

A $10,000 die casting machine has been given to the Metallurgical Engineering Dept. of the Illinois Institute of Technology by the *Doehler-Jarvis Corp.* for use in instruction and research.

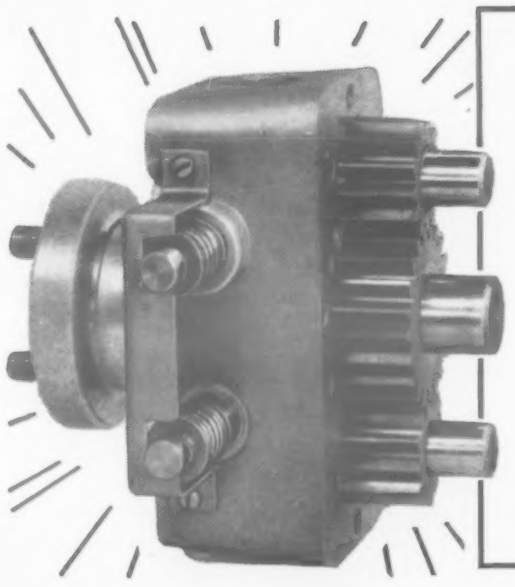
"The Tale of the Powdered Pig," a new sound and color film, has just been released by the *Reynolds Metals Co.* It is available to technical groups in the paint industry and educational organizations. Requests should be directed to the Reynolds Metals Co., Motion Picture Dept., 821 S. 12th St., Louisville 1, Ky.

Societies

The *American Institute of Bolt, Nut & Rivet Manufacturers* has officially changed its name to the *Industrial Fasteners Institute.* The name change in no way affects the present organization, and offices will remain at 1550 Hanna Bldg., Cleveland.

NO "SWISS CHEESE" TEXTURE IN

Char-Lynn DIE CASTINGS



The bigger the die casting, the greater the likelihood of porosity. Char-Lynn engineers are turning out aluminum castings of five and six pounds with uniform density. *It can be done!* The pressure-tight hydraulic pump casting shown here is an example. Take advantage of Char-Lynn consultation service. A tool and die department operates under expert supervision. *Send us a sample or blueprint for free estimate.*

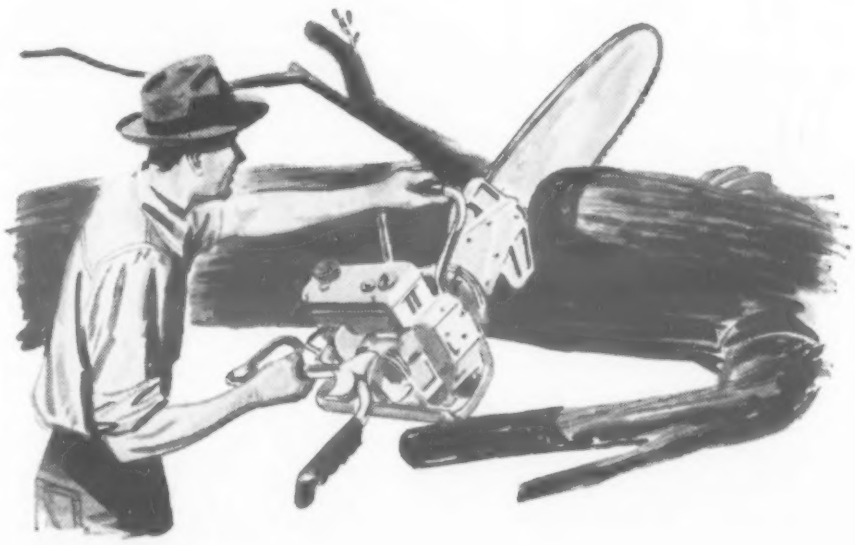
Char-Lynn Company

2875 26th Avenue South • DUpont 2354
Minneapolis 6, Minnesota

Greater ease in use accompanies products made lighter with . . . Dow

MAGNESIUM

the world's lightest structural metal!



If your product is designed to save manpower, one metal—Magnesium—deserves your first consideration.

Magnesium is the world's lightest structural metal. It gives portable tools new found lightness because it is a full one-third lighter than any other light metal. Saws, hand tools and countless other products become easier to lift and move—easier to sell—with magnesium. And this bonus—this premium of lightness—is yours without sacrificing needed strength and durability, because parts made from magnesium are sturdy and long lasting.

Give your product the vital selling advantage of noticeably greater ease in use—switch to magnesium. Write for a free copy of "How Magnesium Pays," a book filled with actual case studies of successful magnesium applications.

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Cut Dead Weight
And Production Costs, Too . . .
With Magnesium Die Castings

Magnesium die castings are the obvious choice for portable equipment. They enable designers to save pounds and dollars at the same time. Magnesium die castings are as strong as they are light. And they can be cast to extremely close tolerances which eliminates much costly machining.

Lighter Products Sell—make your product Magnesium Light

Free Folder!

--tells how to finish ZINC OR CADMIUM for better CORROSION RESISTANCE ...PAINT BASE

Eye Appeal

If your product uses zinc or cadmium in any form, find out now about Iridite . . . the chemical dip finishes that boost corrosion resistance . . . provide a paint base that defies peeling, flaking, chipping . . . brighten zinc, keeps it bright and free from stains. Write for details today . . . or better still, send samples of your product for FREE processing.

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are used on--

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Kitchen Utensils • Aircraft Parts
Lock Hardware • Office Machines
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Wire Cloth • Tools
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Zinc Coated Sheet • Hinges, Screws, Bolts
Camera Parts • Plumbing Fixtures
Wall Panels • Refrigerator Parts
Wire Products • Instrument Parts
Electrical Equipment

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News of...

ENGINEERS COMPANIES SOCIETIES

Dr. J. C. Warren, dean of Graduate Studies and head of the Chemistry Department at the *Carnegie Institute of Technology,* was named president-elect to succeed Dr. Robert E. Doherty, who will retire as Carnegie's president next year.

At the annual meeting of the *Electric Metal Makers Guild, Inc.,* the following officers were elected for the coming year: president—F. O. Lemmon, superintendent of melting, Ohio Steel Foundry Co.; vice president—E. J. Chelius, superintendent of melting, Carnegie Illinois Steel Co.; and secretary-treasurer—R. J. McCurdy, superintendent of melting, Republic Steel Corp.

New York University's College of Engineering has announced the appointment of Professor Mario C. Giannini as assistant dean in charge of the Day Division.

The new Peirce Memorial Laboratory of Metallurgy at the *Stevens Institute of Technology* was formally dedicated last May. The new laboratory, part of the Stevens Science Center, replaces the outgrown Peirce Metals Laboratory, established in 1939 by the late Mr. Peirce.

The *Magnesium Association* elected the following officers for the 1949-1950 term: president—A. W. Winston, Dow Chemical Co.; vice president—H. B. Megill, Dominion Magnesium Ltd.; and treasurer, R. D. Ferguson, Eclipse-Pioneer Div., Bendix Aviation Corp.

George V. Luerssen, chief metallurgist of the Carpenter Steel Co., was presented with the first annual David Ford McFarland Award by the Penn State Chapter of the *American Society for Metals.* The Award is made to a Penn State metallurgist who has attained eminence in his profession so as to bring credit upon himself and upon his Alma Mater.

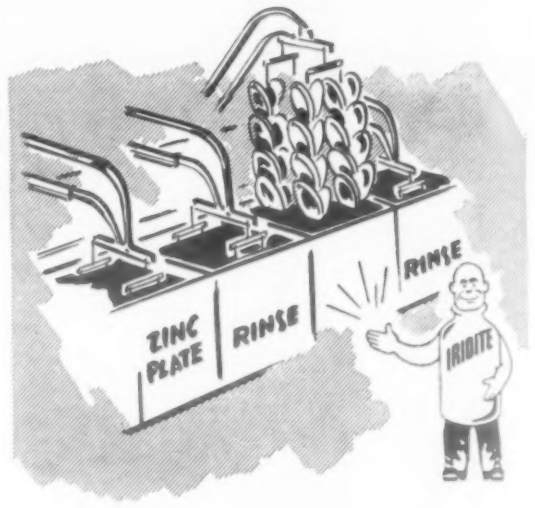
Dr. J. C. Warner, dean of Graduate Studies and head of the Chemistry Dept. at Carnegie Institute of Technology, was elected vice president and a member of the Board of Directors of the *Electrochemical Society.*

Dr. Roy D. Hall was the fifth recipent of the medal awarded annually by the *Stevens Institute of Technology* for outstanding achievement in the field of powder metallurgy. Dr. Hall retired from active service with the Westinghouse Electric Corp. after 38 years of service.

The *Wire Association* has voted to present their Annual Medal Award for 1948 to Reginald S. Brown, chief metallurgist for Rylands Brothers, Ltd. of Warrington, England. The presentation will be made at the Association's annual meeting in October.

(More News on page 130)

Now--a one dip IRIDITE bright finish for AUTOMATIC ZINC PLATING



COMMON CHEMICAL ADDITION ELIMINATES CAUSTIC RINSE— PERMITS AMAZING LOW COST

The one-dip Iridite Bright treatment for standard automatic zinc plating machines has been proved successful and is now being used in product on runs.

RESISTS CORROSION—PROTECTS FROM STAIN

This amazingly low cost protective and brightening process produces a shining stain-free surface with good corrosion resistance . . . utilizing only the normal number of tanks after the zinc plating operation: rinse, Iridite, rinse.

SIMPLE TO OPERATE—NO BLEACHING DIP

This special one-dip Iridite Bright is a non-electrolytic chemical solution . . . operates at 80 to 85° F . . . with no specially trained personnel . . . equally adaptable to bulk plating of parts. Eliminates need for second or bleaching dip.

Whatever your problem in finishing zinc or cadmium — there's an Iridite to do the job. For details, write— wire— or 'phone.

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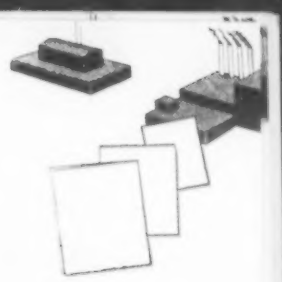


MANUFACTURERS' LITERATURE

Materials

IRON AND STEEL

Proper **Design of Alloy Steel Parts.** The Climax Molybdenum Co. has just released a booklet that stresses the relationship of good design to metallurgical and economic factors, showing by sketches numerous points that influence the behavior of an alloy steel part in service. (1)

Steel Bars. A new bulletin just released by the LaSalle Steel Co. emphasizes the many advantages obtained when using Stressproof cold finished carbon steel bars that possess 4-in-1 in-the-bar qualities — strength, machinability, wearability and minimum warpage. (2)

NONFERROUS METALS

Preformed and Standard Carbide Blanks. The many advantages of using Adamas preformed and standard style blanks in almost any size or shape for a variety of applications are listed in this single sheet, offered by the Adamas Carbide Corp. (3)

Special Alloy for Cast-to-Shape Dies. This 4-page, illustrated bulletin gives complete information on Strenes "C" Metal, a chromium-nickel-molydenum alloy with a high steel base used primarily for cast-to-shape forming and drawing dies. Available from the Advance Foundry Co. (4)

Casting Alloys. R. Lavin & Sons, Inc. has published a compact wall chart that contains detailed specifications, chemical compositions and physical properties of a wide variety of standard brass, bronze, nickel silver and aluminum casting alloys. (5)

NONMETALLIC MATERIALS

Molding Materials and Resins. Typical applications for Beetle and Melmac molding compounds, Urac and Melurac resin adhesives, and Melmac and Laminac laminating resins are attractively illustrated and described in this 12-page bulletin, just released by the Plastics Dept. of the American Cyanamid Co. (6)

Zinc-Base Metals. Samples of both bright and satin finished zinc-base metals, furnished in sheets, coils or flat strips, in striped or crimped patterns, plated on one or two sides, and that can be stamped, blanked, bent or formed to meet most production requirements, are featured in a new bulletin offered by the American Nickeloid Co. Stock sizes and gages are included. (7)

Felt Samples. S.A.E. felt standards and specifications are set forth in an 8-page, sample folder available from the American Felt Co. Samples of 16 different S.A.E. grades are exhibited. (8)

Heat Resistant Acrylic Resin Molding Powder. A detailed chart giving the various properties of Lucite HM-140, an improved heat resistant acrylic resin molding powder available in a wide range of transparent, translucent and opaque colors, is featured in this 4-page bulletin, No. A-9054, released by the Plastics Dept. of the E. I. du Pont de Nemours & Co. (Inc.) (9)

Thermoplastic Cellulose Ester Materials. This 8-page, illustrated bulletin, No. H 1-10, gives complete data on Kodapak Sheet, a thermoplastic cellulose ester material with important applications in the electrical industry. Available in two types —Kodapak I, cellulose acetate, and Kodapak II, cellulose acetate butyrate—from the Cellulose Products Sales Div. of the Eastman Kodak Co. Specifications are included. (10)

Adhesives, Dispersions, Etc. A variety of Loxite adhesives, dispersions, latex and compounded latex dispersions, their outstanding properties and recommended uses are featured in this 20-page, illustrated bulletin, released by the Firestone Industrial Products Co. (11)

Structural Materials. The Haskelite Manufacturing Corp. has issued a 4-page, illustrated bulletin describing its line of structural materials—Plymetl, a group of stiff, strong, lightweight, structural sheet materials; Ornametl, which combines the sales appeal of beautiful woods with the workability of sheet metal; and Ornalite, a bright, colorful patterned surfacing material. (12)

Molding Compound. Complete data on Cerex, a high heat resistant thermoplastic molding compound that can be molded on standard injection machines, can be extruded, and is machinable, are presented in a new bulletin just released by the Plastics Div. of the Monsanto Chemical Co. (13)

Fiberglas Products for Plastics Reinforcement. A variety of Fiberglas products, including yarns, cloths woven of the yarns, mats and chopped strands, that are available for the reinforcement of plastics are described and illustrated in an attractive, 12-page bulletin offered by the Owens-Corning Fiberglas Corp. (14)

To obtain literature appearing on these pages, please refer to easy-to-use reply card on page 127.

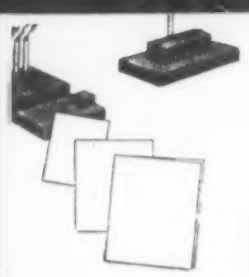
PARTS AND FORMS

Aluminum Impact Extrusions. The principles of the Alcoa impact extrusion process for producing aluminum impact extrusions, and their commercial applications, are interestingly presented by the Aluminum Co. of America in this 44-page, illustrated booklet, No. AD-124. (15)

Aluminum Parts. This attractive, 56-page catalog profusely illustrates and describes the large facilities of the Aluminum Goods Manufacturing Co. for producing aluminum parts, the technical services available, and the wide range of products already made by this company. (16)

Castings. A 60-page booklet that illustrates and describes facilities for the production of cast steel parts and tubes as well as industrial alloy iron castings has been released by the American Cast Iron Pipe Co. (17)

Precision Investment Castings. An interesting article on precision investment castings



MANUFACTURERS' LITERATURE

is presented by the Arwood Precision Casting Corp. in this 16-page, illustrated bulletin, including a table of alloys found by Arwood to be most adaptable to its process. (18)

Porous Bronze Bearings. This 16-page, illustrated bulletin lists hundreds of sizes and types of "Compo" oil-retaining porous bronze bearings carried in stock, and gives bearing formulae, tolerances, loads and specifications. Available from the Bound Brook Oil-Less Bearing Co. (19)

Magnesium Die Castings. The physical properties, relative weights, typical applications and numerous advantages of using Doler-Mag magnesium die castings are featured in a 4-page, illustrated bulletin, published by the Doehler-Jarvis Corp. (20)

Plaster Mold Castings. The new Bendix process of plaster mold casting a wide range of cylindrical shapes to tolerances as close as ±0.005 in. in mass production while maintaining low weight, high strength, uniform physical properties and smooth finish is discussed in this 4-page bulletin, No. 811-12A, issued by the Eclipse-Pioneer Div. of the Bendix Aviation Corp. Complex parts cast in one piece that previously had to be cast in sections so that inner surfaces could be machined are illustrated. (21)

Injection Molded Plastics. The facilities of the Plastics Div. of the Erie Resistor Corp. for producing custom injection molded plastics, and a wide variety of typical applications requiring precision within exacting tolerances, are profusely illustrated and described in this 8-page bulletin. (22)

Sintered Carbide Tips, Tools, Etc. Specifications and prices of a complete line of Firthite sintered tungsten carbide tips and tools, boring bits, Mechanigript adjustable tool holders, and special tips, nibs and wear parts made to customers' specifications are featured in this 28-page, illustrated catalog, No. FE-127, offered by the Firth Sterling Steel & Carbide Corp. (23)

Flexible Tubing. This 6-page, illustrated folder presents the outstanding features of Spiratube flexible tubing (the spring core is spiral-stitched into the fabric) for use in conveying air, gases, light solids and similar elements. Specifications and various applications are also included in this bulletin, available from the Flexible Tubing Corp. (24)

Cemented Carbide Products. Specifications, typical applications and prices of a complete line of cemented carbide tools, mills, drills, files, wear resistant parts, etc. produced by Kennametal, Inc. are featured in this 80-page, illustrated catalog, No. 49. (25)

Aluminum Extruded Shapes. Illustrations of a variety of aluminum extruded shapes and fabrications, and the facilities of the Light Metals Corp. to produce these shapes to meet customers' specifications are featured in this 6-page folder. (26)

Flexible Couplings. The many attractive advantages of using torsionally soft flexible couplings ranging in size from 1/50 to 100 h.p. in a product or factory are listed in a 4-page, illustrated bulletin, No. 201, released by the Lord Manufacturing Co. Specifications are included. (27)

Iron Castings. A detailed tabular summary listing the physical properties of the general engineering types of Meehanite castings produced by the Meehanite Metal Corp. is featured in this 4-page, illustrated bulletin, No. 32. (28)

Stainless Steel and Heat Resisting Alloy Castings. A compact corrosion guide and nine technical data sheets, containing tables on chemical compositions, physical, mechanical, heat and corrosion resisting properties, etc. of a complete line of Misco stainless steel castings and heat resisting alloy castings, has been issued by the Michigan Steel Casting Co. (29)

Metal Filter Cloth. Samples of metal filter cloth from 40 to 700 mesh, in nickel, Monel, brass, Chromel and stainless steel, available in plain, twilled, plain dutch and twilled dutch weaves, are included in a pocket-size booklet offered by the Michigan Wire Cloth Co. (30)

Friction-Minimizing Bearings. A complete line of friction-minimizing, self-lubricating Morganite bearings, including metallic and nonmetallic content bearings, composite bearings, and machined or molded shapes of special quality, self-lubricating materials, is fully described and illustrated in a 6-page folder released by the Morganite Brush Co., Inc. (31)

Zinc Alloy Die Castings. The more salient features of Zamak-3 and Zamak-5 zinc alloy die castings, their method of production, and typical applications are all reviewed in this 28-page, illustrated booklet, available from the New Jersey Zinc Co. (32)

Forgings. The history, manufacturing facilities and typical applications of the Pittsburgh Forgings Co. and its subsidiary, the Greenville Steel Car Co., producers of duplicate, interchangeable forgings made in closed dies for assembly into all types of industrial equipment, are attractively presented in a 64-page, illustrated catalog. (33)

Powdered Metal Parts. A broad range of new applications for powdered metal fabrication processes, as well as a table of physical properties of various Powdermet parts, is presented by the Powdered Metal Products Corp. of America in a new 8-page, illustrated bulletin. (34)

Stainless Steel Castings and Specialties. A variety of stainless steel castings, regulator and valve parts, centrifugal pump impellers, etc. are profusely illustrated and described in this 4-page folder, issued by the Stainless Foundry & Engineering Co. One page of the bulletin is filled with helpful engineering data. (35)

Precision Machined Fittings. The use of corrosion resistant Sta-Unions—precision machined fittings—for the joining of stainless steel tubing, making possible the use of light or heavy gage tubing in place of pipe, thus reducing both weight and cost, is discussed in a single, illustrated sheet released by the Steel Products Co. (36)

Continuous Rolled Metal Shapes. This 12-page supplement to Catalog J of the Van Huffel Tube Corp. illustrates a large number of additional continuous rolled metal shapes prodced by this company. (37)

COATINGS AND FINISHES

Corrosion Resistant Coating. Iridite, a quick dip process for corrosion resistance as a paint base or final finish on all zinc or cadmium surfaces, is discussed in a 4-page, illustrated bulletin offered by Allied Research Products, Inc. (38)

Plastic Coatings. This 8-page, pocket-size folder describes and illustrates Liquid Envelope, a peelable, plastic, protective coating that can be applied by brush, spray or dip in a variety of different applications. Available from Better Finishes & Coatings, Inc. (39)

Metallizing for Corrosion Protection. Examples of a variety of iron and steel equipment that were metallized with either zinc or aluminum, thus affording 15 to 20 years of protection against rust and corrosion, are described and illustrated in this 8-page bulletin, No. 62, offered by the Metallizing Engineering Co., Inc. (40)

Silicone-Base Heat Resistant Finish. The Midland Industrial Finishes Co. has issued a 4-page, illustrated bulletin discussing its new Mico silicone-base aluminum finish that can be applied by brush, dip or spray application on a wide range of products where high heat resistance is required for proper surface protection. (41)

Acid- and Alkali-Proof Tank Lining. Complete data on Nukemite 35, an acid- and alkali-proof tank lining that combines ease of application of a liquid coating with the immunity and long service life of good sheet membrane linings, are presented by Nukem Products Corp. in a 4-page bulletin. (42)

Rust Protector and Finish. The many outstanding advantages offered by the Parkerizing process for protecting iron and steel surfaces from rust and corrosion and providing a thoroughly acceptable type of finish for many articles are presented by the Parker Rust Proof Co. in an attractive, 24-page, illustrated catalog, No. A-2511. (43)

Protective Coatings. The use of Westoflex 80, a tough, flexible, rubber-like coating, as a lining or coating in the electroplating, metal working, metal finishing, chemical and process equipment industries, Westoflex Adhesive for bonding Westoflex to metal, Westoflex 65 for the plastics indus-

try, etc. is discussed in a 6-page data sheet, published by the Western Coating Co. (44)

Methods and Equipment

MANUFACTURERS' LITERATURE

HEAT TREATING AND HEATING

Continuous Automatic Quenching Tanks. Detailed specifications of a complete line of continuous automatic quenching tanks and several typical factory installations are featured in this 4-page, illustrated bulletin, No. 820, issued by the American Gas Furnace Co. (45)

Super Refractories for Heat Treatment Furnaces. A concise description of a variety of super refractories for heat treatment furnaces, their physical characteristics, how they are applied to specific types of furnaces, operational advantages, installation data, and numerous tables comprise this 40-page, illustrated bulletin offered by the Refractories Div. of the Carborundum Co. (46)

Electric Laboratory Furnaces. Bulletin No. 48A, two pages, describes and illustrates electric laboratory furnaces for experimental testing, enameling, fusing, igniting, precipitate drying and ashing in physical and chemical laboratories, and as pilot furnaces in metallurgical laboratories. Specifications are included in this bulletin, issued by the Cooley Electric Manufacturing Corp. (47)

Air Heaters. The D.J. direct gas air heater, the I.H. indirect gas air heater, steam air heaters and electric air heaters for baking finishes, heat treating, drying, curing phenolic resins, etc. are described in an 8-page, illustrated bulletin, No. H, issued by Gehnrich & Gehnrich, Inc. Detailed specifications are included. (48)

Electric Heaters. The attainment of uniform air temperatures, adaptability and cleanliness when using electric heaters for process-air heating is discussed by the General Electric Co. in this 8-page, illustrated bulletin, No. GET-1741. (49)

High Temperature Elecrtic Tube Furnace. Bulletin No. 1148, published by the Harper Electric Furnace Corp., describes and illustrates a high temperature electric tube furnace especially designed for general research work. A useful chart of typical heating and cooling curves is included. (50)

Liquid Electrode Furnace. The principle of operation of the new liquid electrode furnace 601 that eliminates salt bath breakdown, offers 35 to 55% lower operating cost, etc., and a wide range of applications, are featured in this 4-page, illustrated bulletin, issued by the A. F. Holden Co. (51)

Heat Treating Unit. Complete data on the Series T universal heat treating unit that is fully automatic, sealed and atmosphere-controlled are presented by Ipsen Industries, Inc. in a 4-page, illustrated bulletin. Specifications are included. (52)

Flame Hardening Machine. The principal elements of the flame hardening process and their automatic control by the Denver Electronic universal flame hardener are graphically shown in a 2-page chart, part of a 20-page, illustrated bulletin covering the electronic and mechanical engineering details of this process. Available from the Stearns-Roger Manufacturing Co. (53)

CLEANING AND FINISHING

Rust Remover. Five outstanding advantages received when using Diversey Everite for safely removing rust, heat scale, hard water scale and discolorations from metal surfaces are listed in this single, illustrated sheet issued by the Diversey Corp. (54)

Bench Rectifiers. Specifications for three models of 8- and 16-volt rectifiers—portable (150, 200 watts), small bench type (300, 400 watts), and medium bench type (450, 1200 watts)—are included in this 4-page, illustrated bulletin, second edition, offered by the W. Green Electric Co., Inc. (55)

Electroplating, Buffing and Polishing Equipment. A complete line of equipment and supplies for electroplating, buffing and polishing operations, including polishing wheels, brushes, chemicals, anodes, etc., is listed in this 6-page, illustrated folder, offered by Munning & Munning, Inc. (56)

Blast Cleaning Equipment. The many advantages of using the Pangborn Rotoblast Barrel for cleaning any type casting faster, better and cheaper are discussed in bulletin No. 214, just released by the Pangborn Corp. (57)

Rotary Industrial Brushes. This 4-page bulletin describes and illustrates Perfect Ballance rotary industrial brushes with sections, wheels and cups made from coarse or fine wire or tampico. Available from the Brush Div. of the Pittsburgh Plate Glass Co. (58)

Wet and Dry Flexible Belt Surfacers. Bulletin No. 645, two pages, describes and illustrates both the B-6W and B-6D wet and dry flexible belt surfacers for grinding, sanding and polishing curved and irregular as well as flat surfaces. Detailed specifications are included in this bulletin, available from the Porter-Cable Machine Co. (59)

WELDING AND JOINING

Stainless Steel Fasteners. All types and sizes of stainless steel machine, self-tapping, socket, set and wood screws, nuts, bolts, washers, rivets and pins are described and illustrated in bulletin No. 49E, offered by the Allmetal Screw Products Co. (60)

Industrial Fasteners. Time and money-saving case histories that show how Bostitch machines for stapling and wire stitching render better and faster work are reviewed by Bostitch, Inc. in its 16-page, illustrated bulletin, No. PTG 223. (61)

Welding Positioners. A profusely illustrated circular of Cullen-Friestedt Co. examines the factors involved in handling weldments of various sizes and shapes, and describes the use of positioners to provide economy, convenience and safety. (62)

Bench Welders. Detailed specifications of a complete line of BA Series resistance bench welders in 5-, 10-, 20-, 30- and 50-Kva. capacities are featured in a 4-page, illustrated bulletin, No. 4860, released by the Federal Machine & Welder Co. (63)

Wetting and Bonding Characteristics of Silver Brazing Alloys. Part 2 of a series of

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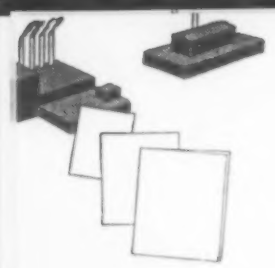

MANUFACTURERS' LITERATURE

technical bulletins on several types of low temperature silver brazing alloys discusses the wetting and bonding characteristics of these alloys. Illustrations showing how different brazing alloys flow on different metals are included in this 4-page bulletin, No. T-2, offered by Handy & Harman. (64)

A Guide to Better Welding. The Hobart Brothers Co. has issued a handy, pocket-size, 30-page booklet, No. EW-126, containing complete information on short cuts for better welding. Numerous tables and illustrations greatly help the reader. (65)

Resin Glue Guide. A handy slide-rule type chart for obtaining the cost per 1,000 sq. ft. of Plaskon resin glue, time-temperature-thickness schedules for these glues, and complete operating data for five free-flowing powdered glues, is available from the Plaskon Div. of the Libbey-Owens-Ford Glass Co. (66)

Hardsurfacing Electrodes. Typical applications, detailed operating procedures and a hardsurfacing guide for a variety of hardsurfacing electrodes comprise this 4-page, illustrated bulletin, No. 469, available from the Lincoln Electric Co. (67)

Lock Nuts. Detailed specifications of a variety of Palnut lock nuts offering double locking action, for use on lamps, lighting fixtures and switches, are featured in this 4-page, illustrated bulletin, No. 551, available from the Palnut Co. (68)

FORGING AND FORMING

Wire Straightening and Cutting Machines. The mechanical advantages and operating instructions of five types of Shuster wire straightening and cutting machines are featured in this 4-page, illustrated bulletin, issued by Mettler Machine Tool, Inc. (69)

High-Speed Forging Presses. Considerable saving in die casts and press maintenance through the use of high-speed forging presses rather than forging hammers is the theme of an interesting 16-page, illustrated reprint, No. 83, published by the National Machinery Co. (70)

Hole Punching Units. The Wales-Strippit Corp. has just published a 16-page bulletin, No. CJ, describing and illustrating its complete line of Type "CJ" hole punching units for punching mild steel up to ¼-in. thick. Specifications and helpful diagrams are included. (71)

MACHINING

Contour Machines. Six different models of contour machines that perform three separate operations—sawing, filing and polishing—are described and illustrated in this 4-page bulletin, No. 47-205, issued by the DoAll Co. Typical applications and specifications are included. (72)

Resinoid-Bonded Diamond Wheels. A new 36-page catalog containing complete information, including specifications and list prices, on its line of resinoid-bonded diamond wheels that will not load or glaze when contacting soft or hardened tool steel while grinding carbide-tipped tools, has been published by the Manhattan Rubber Div., Raybestos-Manhattan, Inc. (73)

Grinding Nonferrous Cast Alloy Cutting Tools. Complete data on grinding nonferrous cast alloy cutting tools are presented by the Norton Co. in an attractive, 30-page, illustrated booklet, No. 571-12P. The proper grinding wheels for each operation are recommended. (74)

Adjustable Perforating Dies. Specifications and prices of a complete line of adjustable perforating dies for perforating materials up to and including ⅛-in. mild steel are included in this compact, 40-page, illustrated catalog, No. 48, published by S. B. Whistler & Sons, Inc. (75)

MELTING, CASTING AND MOLDING

Mold Making with Low Temperature Melting Alloys. The Cerro de Pasco Copper Corp. has issued an informative, 8-page bulletin giving complete data on mold making with Cerro low temperature melting alloys. (76)

INSPECTION AND CONTROL

Semi-Automatic Carbon Determinator. The Leco No. 4000 semi-automatic carbon determinator, which offers ease of operation and speedier analyses by eliminating the raising and lowering of the leveling bottle, is described and illustrated in a 2-page bulletin released by the Laboratory Equipment Corp. (77)

High Temperature Furnace, Control Panel. This 4-page bulletin describes and illustrates a new high temperature furnace for creep or stress-strain-rupture tests made at elevated temperatures, and a control panel that affords more accurate control over prolonged testing periods. Specifications are included in this bulletin, released by the L. H. Marshall Co. (78)

Immersion Pyrometer. Bulletin No. 150, four pages, describes and illustrates two models of the new Pyro immersion pyrometer with instantly interchangeable "Bare Metal" and "Protected" type thermocouples for use in all nonferrous industries. The Pyrometer Instrument Co. includes specifications in this new bulletin. (79)

General

Wet Grinding Mills. A complete line of conical ball and pebble mills, convex-head cylindrical and rod mills, feeders, dryers, etc. is described and illustrated in this 16-page bulletin, No. AH-389, offered by Hardinge Co., Inc. Specifications and typical applications are included. (80)

Metal Fabrication. The complete story of the experience, knowledge and facilities of L. O. Koven & Brother, Inc., metal fabricators of standard and special equipment and apparatus for processing, material handling and storage for all industries, is presented in this attractive, 24-page, illustrated bulletin, No. 490. (81)

Speed Regulator. Complete data on the Reliance Section Interlock Regulator for use in coordinated processes in the paper, rubber and plastics industries requiring extremely accurate synchronization of multi-motor drive speeds are presented by the Reliance Electric & Engineering Co. in a 2-page, illustrated bulletin, No. K 2325. (82)

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Meetings and Expositions

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, Instruments & Regulators Div. conference. St. Louis, Mo. Sept. 12-16, 1949.

INSTRUMENT SOCIETY OF AMERICA, annual meeting. St. Louis, Mo. Sept. 12-16, 1949.

SOCIETY OF AUTOMOTIVE ENGINEERS, tractor meeting. Portland, Ore. Sept. 13-15, 1949.

PORCELAIN ENAMEL INSTITUTE, annual forum. Columbus, Ohio. Sept. 14-16, 1949.

MAGNESIUM ASSOCIATION, quarterly meeting. Detroit, Mich. Sept. 15-16, 1949.

AMERICAN CHEMICAL SOCIETY, national meeting. Atlantic City, N. J. Sept. 19-23, 1949.

ILLUMINATING ENGINEERING SOCIETY, national meeting. Atlantic City, N. J. Sept. 19-23, 1949.

NATIONAL ASSOCIATION OF FOREMEN, annual convention. Detroit, Mich. Sept. 21-24, 1949.

AMERICAN MINING CONGRESS, Western fall meeting. Spokane, Wash. Sept. 25-28, 1949.

AMERICAN INSTITUTE OF MINING & METALLURGICAL ENGINEERS, mid-year meeting. Columbus, Ohio. Sept. 25-Oct. 1, 1949.

NATIONAL ELECTRONICS CONFERENCE. Chicago, Ill. Sept. 26-28, 1949.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, Wood Industries Div. conference. Jamestown, N. Y. Sept. 27, 1949.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, fall meeting. Erie, Pa. Sept. 28-30, 1949.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, Petroleum Div. conference. Oklahoma City, Okla. Oct. 2-5, 1949.

STEEL FOUNDERS' SOCIETY OF AMERICA, fall meeting. White Sulphur Springs, W. Va. Oct. 3-4, 1949.

AMERICAN COKE & COAL CHEMICALS INSTITUTE, annual meeting. Washington, D. C. Oct. 3-5, 1949.

NATIONAL LUBRICATING GREASE INSTITUTE, annual meeting. New Orleans, La. Oct. 3-5, 1949.

ASSOCIATION OF IRON & STEEL ENGINEERS, annual convention. Pittsburgh, Pa. Oct. 3-6, 1949.

INDUSTRIAL PACKAGING & MATERIALS HANDLING EXPOSITION. Detroit, Mich. Oct. 4-7, 1949.

AMERICAN INSTITUTE OF MINING & METALLURGICAL ENGINEERS, Petroleum Div. fall meeting. San Antonio, Tex. Oct. 5-7, 1949.

SOCIETY OF AUTOMOTIVE ENGINEERS, aeronautic and aircraft engineering display. Los Angeles, Calif. Oct. 5-8, 1949.

AMERICAN SOCIETY FOR TESTING MATERIALS, Pacific Area national meeting. San Francisco, Calif. Oct. 10-14, 1949.

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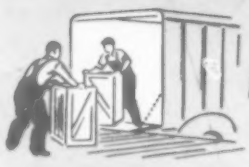

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BOOK REVIEWS

Cathodic Protection

CATHODIC PROTECTION — A SYMPOSIUM. *By the Electrochemical Society and the National Association of Corrosion Engineers. Published by the National Assn. of Corrosion Engineers, Houston 2, Tex., 1949. Cloth, 8½ x 11¼ in., 203 pages. Price $8.00 ($6.00 to members of either Society).* Twenty-three papers given at a Joint Symposium of Cathodic Protection in December, 1947 in Pittsburgh, Pa., are collected in this volume. They provide information on the state of development of the basic principles of cathodic protection and their application to the control of corrosion.

The titles of the papers follow: Electrochemical Principles of Cathodic Protection; Characteristics and Field Use of Electrical Instruments for Corrosion Investigations and Cathodic Protection; Characteristics of Half-Cells Used as Reference Electrodes; Laboratory Methods for Determining the Current Density Required for Cathodic Protection; Current Required for Cathodic Protection; Detection, Measurement and Mitigation of Stray-Current Electrolysis; Detection and Measurement of Currents Other than Stray Currents, Including Magnetic Earth Currents; Coordination of Cathodic Protective Installations to Avoid Interference with Adjacent Structures; Use of Rectifiers as an External Source of Protective Currents; Use of Wind-Driven Generators as an External Source of Protective Currents; Economic Factors Bearing on Application of Cathodic Protection; Locations and Materials for Anodes for Impressed Current; Relative Merits of Various Cathodic Protection Current Sources; Physical and Chemical Characteristics of Zinc Anodes; Current Output of Light Metal Galvanic Anodes as a Function of Soil Resistivity; Fundamental Characteristics of Magnesium Galvanic Anodes; Practical Use of Galvanic Anodes; Behavior of Experimental Zinc-Iron Couples Underground; Anodic Behavior of Zinc and Aluminum-Zinc Alloys in Sea Water; Corrosion and Protection of Underground Power Cables; Effect of Environment Characteristics on Cathodic System Design; Relations between Protective Coatings and Cathodic Protection; and Cathodic Protection in the Control of Stress Corrosion Cracking.

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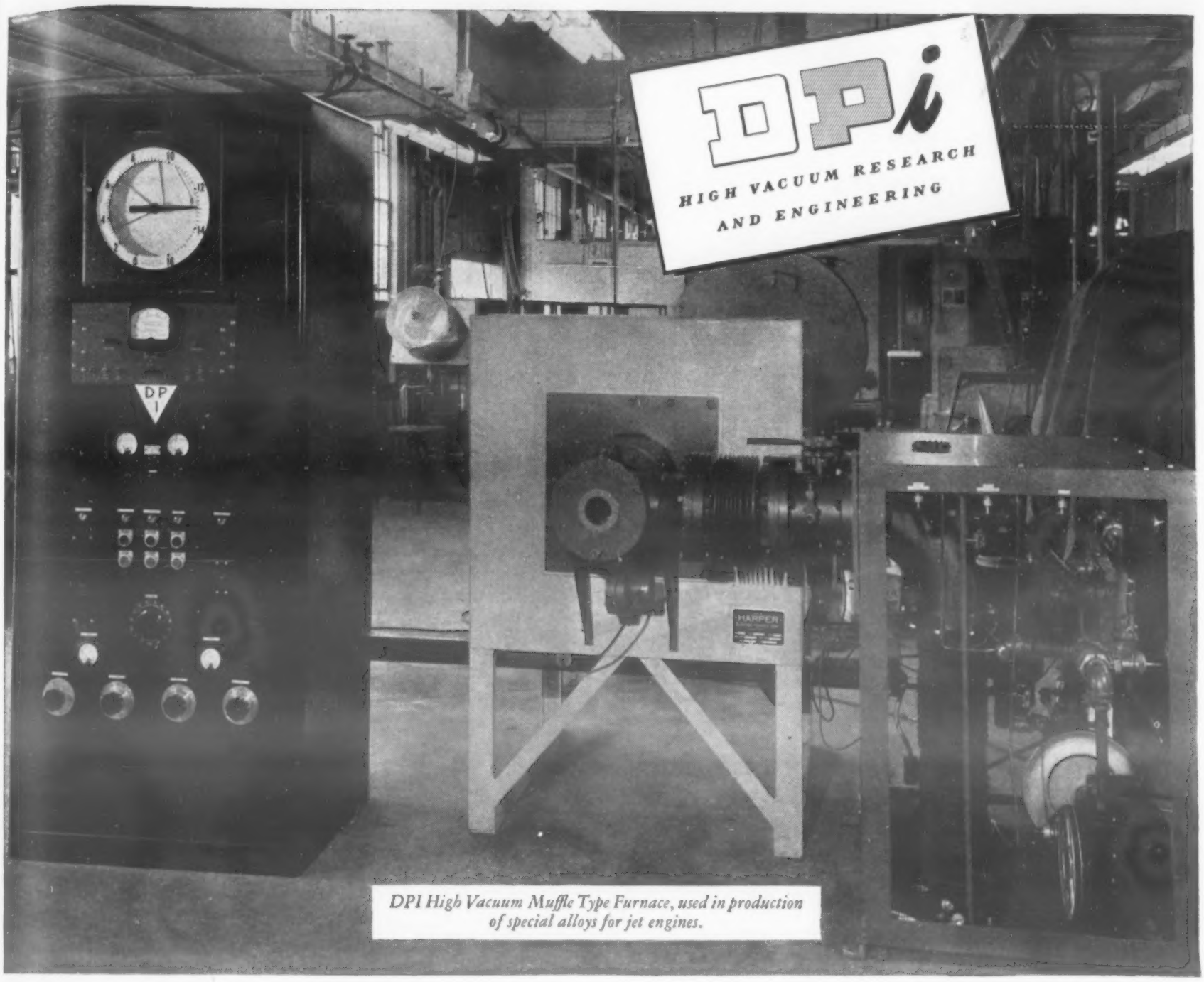

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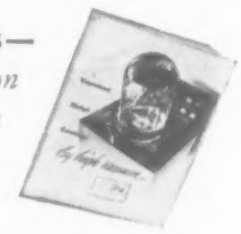

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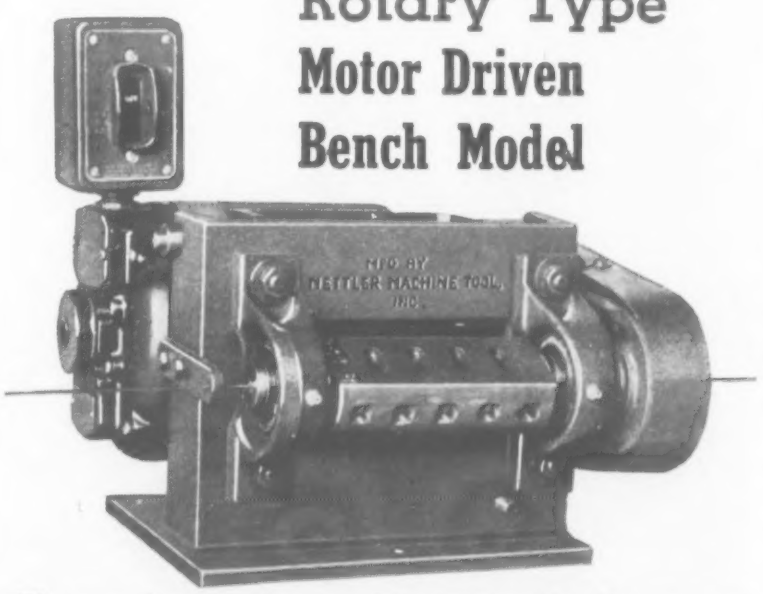

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The stripped wire is merely pushed into the ends of the splice forcing the jaws of the chucks to open as they move back on the taper. The spring between the chucks keeps the teeth of the collet type jaws in contact with the wire until they obtain a good grip. From that point on, the greater the tension, the tighter the jaws grip.

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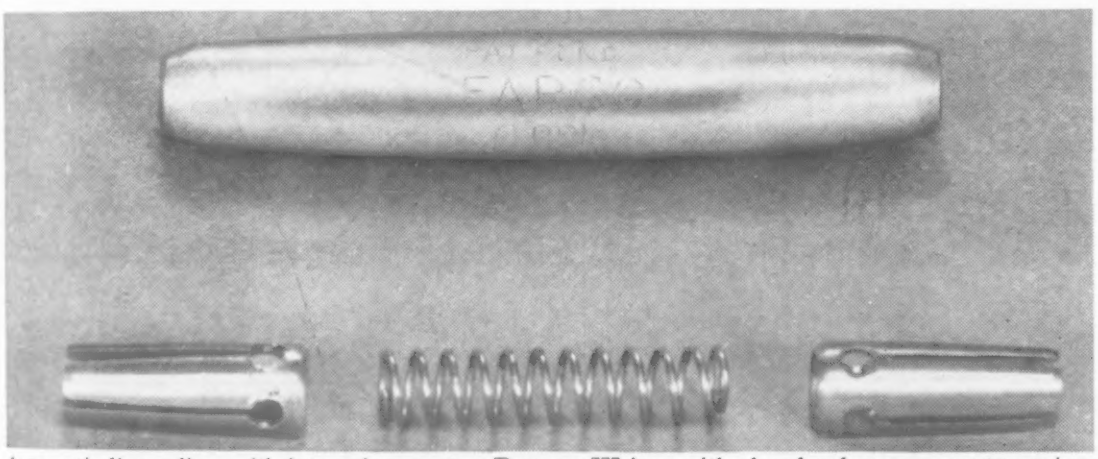

Automatic line splicer with internal parts—two Duronze III jaws with phosphor bronze separator spring. Courtesy Fargo Mfg. Co., Poughkeepsie, N. Y.

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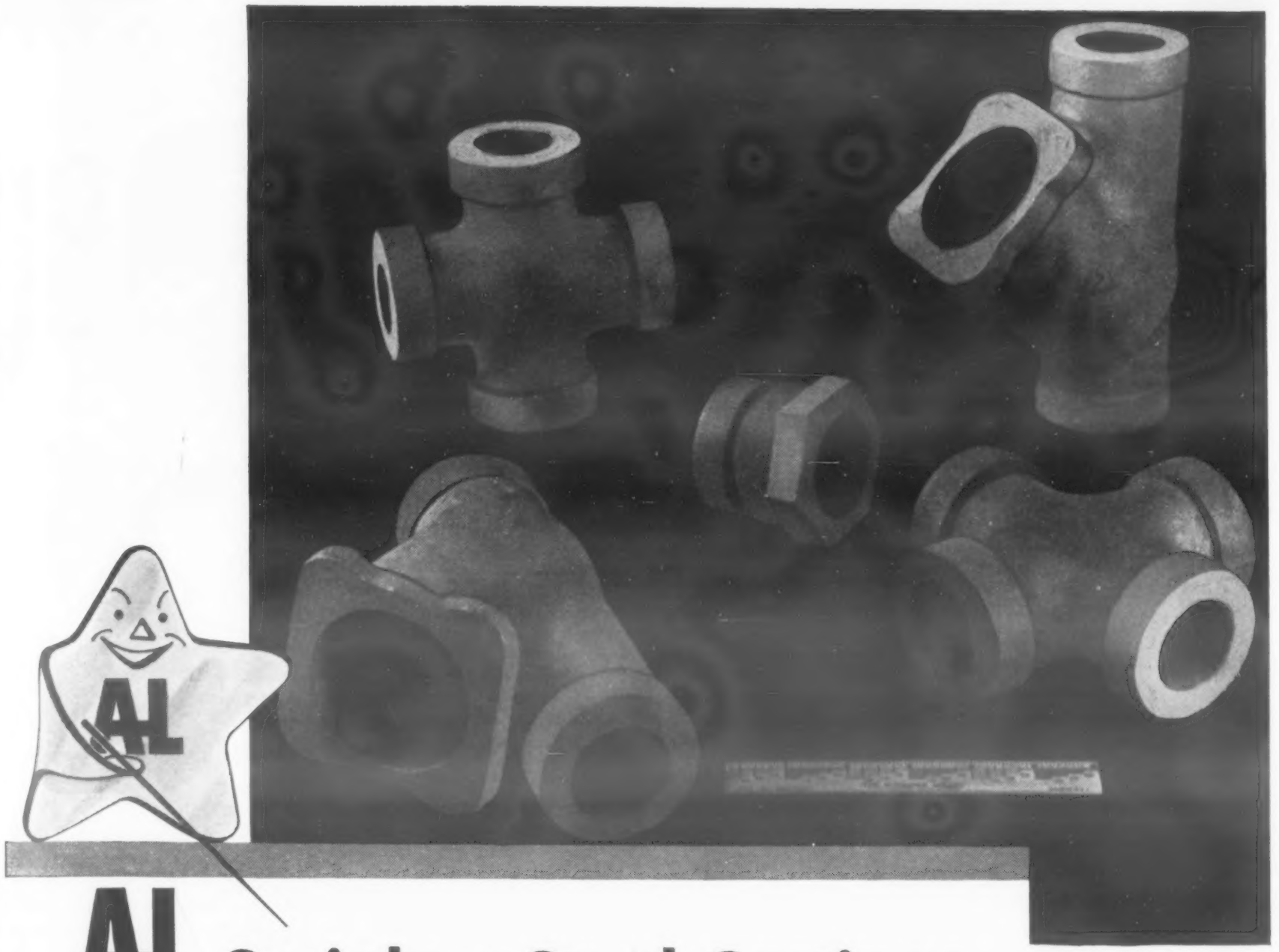

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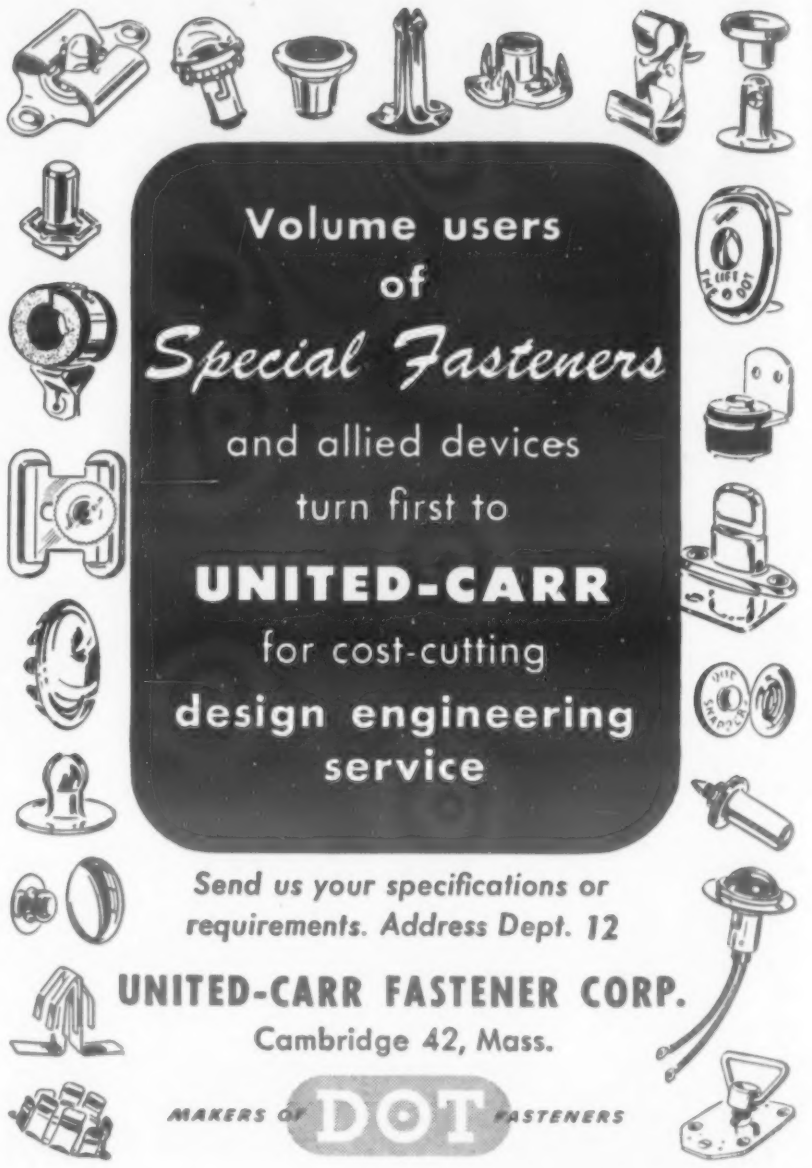

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The Last WORD

by **FRED P. PETERS,** *Editorial Director*

The Materials Engineer's Lexicon

No technical or professional field can be considered as fully mature until it can boast a lexicon or dictionary or glossary defining its essential terms. Because its publication is inevitably the signal for the authorities in the field to have at each other for fair, with a terrible toll in ruined reputations and broken blood vessels, the authority who slipped this one under our door has preferred to remain anonymous.

Any resemblance between these definitions and the true meanings of the words defined is purely coincidental.

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Readers will probably not share our sorrow when they learn that this month represents the last edition of "The Last Word." Your correspondent's other and less pleasant duties have become so pressing that he has asked to be relieved of this assignment, so that the page can be filled with more important and more carefully prepared copy.

Henceforth, starting with the September issue, you will find here the editorial words of wisdom of Mr. Du Mond, transferred from their present position at the beginning of the magazine's feature section. Read and heed, for Mr. Du is true, and you will profit thereby!

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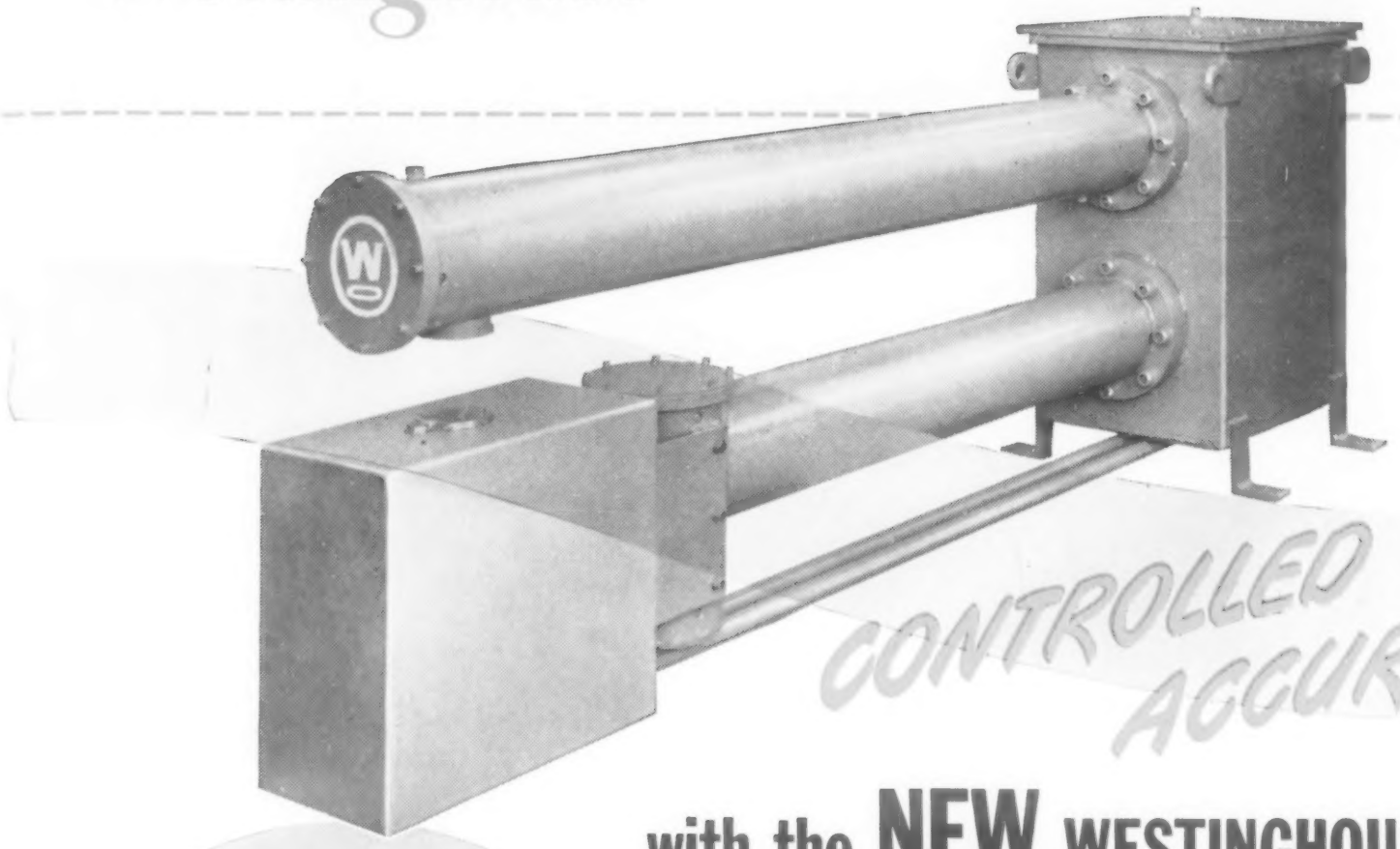

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